CHAPTER 3

Affected Environment

3.1 Introduction

This chapter describes the affected environment for resources potentially affected by implementing the Proposed Action and the alternatives. The affected environment is referred to in this EIS as the Primary Assessment Area, which is the focus of the impacts analysis presented in Chapter 4. The Primary Assessment Area includes the commercial timberlands within those portions of 11 HPAs on the west slopes of the Klamath Mountains and the Coast Range in California where Simpson operates or could operate in the future.[1] Simpson currently owns and operates on 416,531 acres within the 11 HPAs, but could expand within the 11 HPAs by approximately 267,142 acres. Simpson lands, therefore, represent approximately 61 percent of the 683,673 acres comprising the Primary Assessment Area. As discussed in greater detail in Sections 5 and 7 of Simpson's proposed AHCP / CCAA, general habitat and relevant environmental conditions, as well as the potential impacts to the covered species, are sufficiently similar across the Primary Assessment Area to support the application of conservation measures contained in the proposed AHCP / CCAA on any lands on which Simpson operates within the 11 HPAs during the term of the permits. For purposes of analysis, site-specific information on Simpson-owned lands have been extrapolated to other commercial timberlands within the Primary Assessment Area.

In addition to the Primary Assessment Area lands analyzed in this EIS, the regional setting is described to provide an overall context for the analysis of the Primary Assessment Area in Chapter 4. The regional setting addresses those portions of the 11 HPAs that include the Primary Assessment Area as well as areas that are not part of the Primary Assessment Area.

An additional 26,116 acres of rain-on-snow areas within Trinity and Del Norte counties, outside of the 11 HPAs are described in this chapter to provide the setting for Alternative C (Expanded Species and Geographic Coverage). The impacts of the 26, 116 acres included as part of Alternative C are presented in Chapter 4.

The following resource categories were selected for detailed analysis in the EIS.

- Section 3.2 – Geology, Geomorphology, and Mineral Resources
- Section 3.3 – Hydrology and Water Quality
- Section 3.4 – Aquatic Resources
- Section 3.5 – Vegetation / Plant Species of Concern
- Section 3.6 – Terrestrial Habitat / Wildlife Species of Concern
- Section 3.7 – Air Quality
- Section 3.8 – Visual Resources
- Section 3.9 – Recreational Resources
- Section 3.10 – Cultural Resources

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[1] This includes all commercial timberlands, with the exception of lands owned by Pacific Lumber Company, within the 11 HPAs.

- Section 3.11 – Land Use
- Section 3.12 – Social and Economic Conditions

Because no differences in noise effects are expected as a result of issuing the proposed incidental take permit, noise issues do not warrant further analysis.

3.2 Geology, Geomorphology, and Mineral Resources

3.2.1 Introduction

North coastal California includes some of the most rapidly eroding areas in the United States. Streams draining the area, such as the Eel River, have some of the highest suspended sediment loads per unit area recorded in the world (Judson and Ritter, 1964). One fundamental reason for this occurrence is the unstable geology of the Coast Range (California Department of Water Resources (CDWR), 1982). A basic knowledge of the geology and geomorphology of the region is essential to understanding the environmental condition of the area. The following sections provide a description of the geology and geomorphology found within the Primary Assessment Area. The information presented below is intended to provide a broad overview of how geologic characteristics such as bedrock composition, bedrock structure, and tectonic uplift relate to topography, hillslope mass wasting, and erosion in the region.

3.2.2 Regional Geology

The Primary Assessment Area is located mostly within California's Coast Ranges geologic province. The eastern margin of the northern part of the Primary Assessment Area is within the Klamath Mountains geologic province (Figure 3.2-1). These provinces include a complex of various geologic terranes that collectively are within the convergent margin of the North American plate. Within the individual provinces and terranes, geomorphic conditions vary widely.

On a regional scale, the bedrock in the Primary Assessment Area is a composite of accreted oceanic rocks and pre- and post-accretionary plutonic rocks that are overlain in places by younger depositional strata. Locally, the bedrock can vary greatly, ranging from deeply weathered sandstone and mudstone, to metasedimentary rock, greenstone, and ultramafic bedrock.

The geologic structure of the region generally is dominated by a series of north to northwest trending faults. The faults correspond to topographic highs (such as the South Fork Mountain Fault) and topographic lows (such as the Grogan Fault). Numerous northwest-trending anticlines and synclines are associated with the faulting and also contribute to the shape of the landscape.

The extensive uplift of the region is well known. The height of the mountains and the high elevation of bedrock that is composed of marine sediments and ultramafic ophiolite sequences are the most obvious indicators of this uplift.

Accretion, deformation, and uplift of the region is ongoing today, as interactions continue between the Gorda, Pacific, and North American tectonic plates along the continental margin. Slip rates along the major thrust faults in the area is on the order of several millimeters per year (California Geological Service [CGS]).

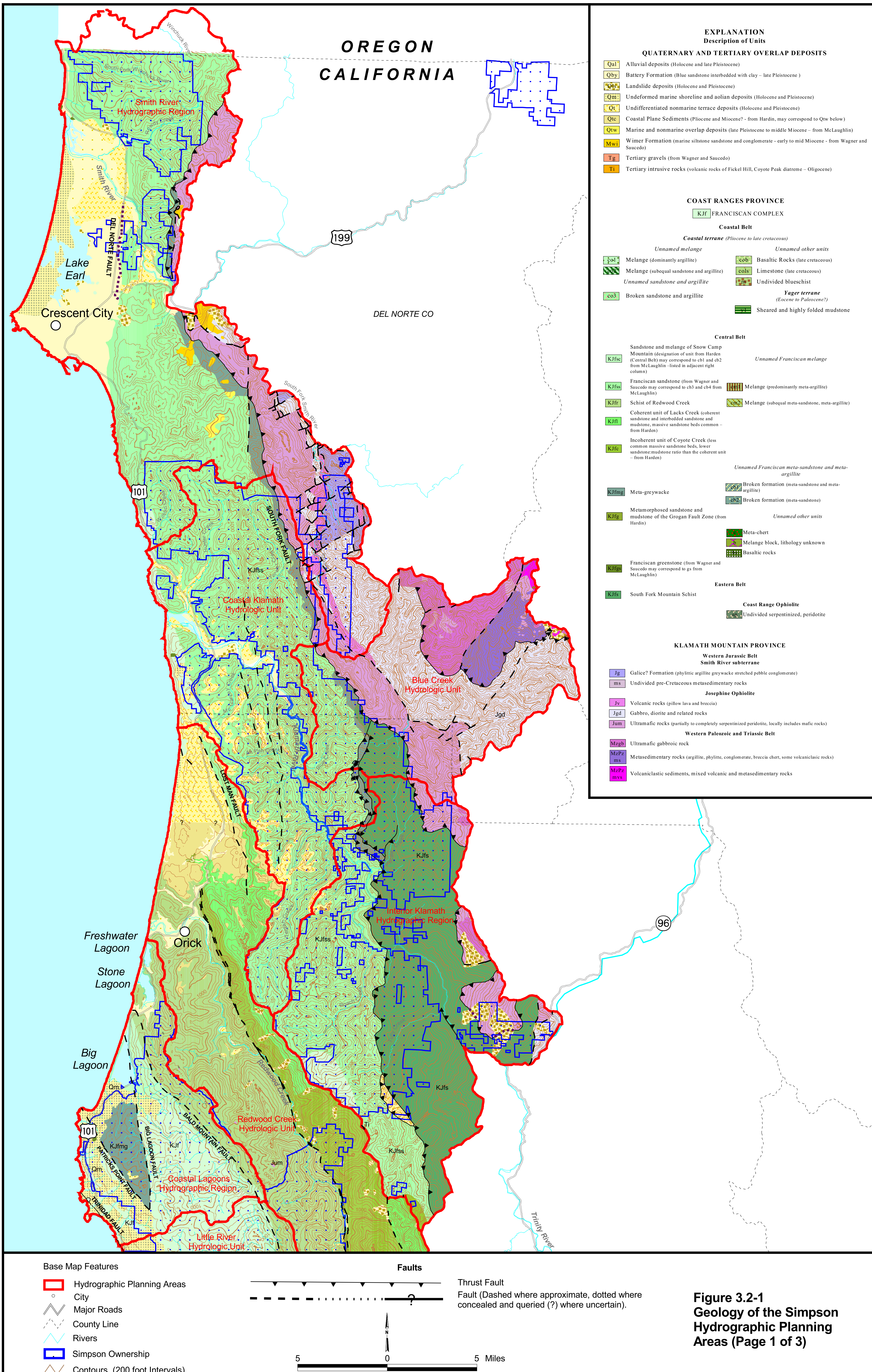

Figure 3.2-1
Geology of the Simpson Hydrographic Planning Areas (Page 1 of 3)

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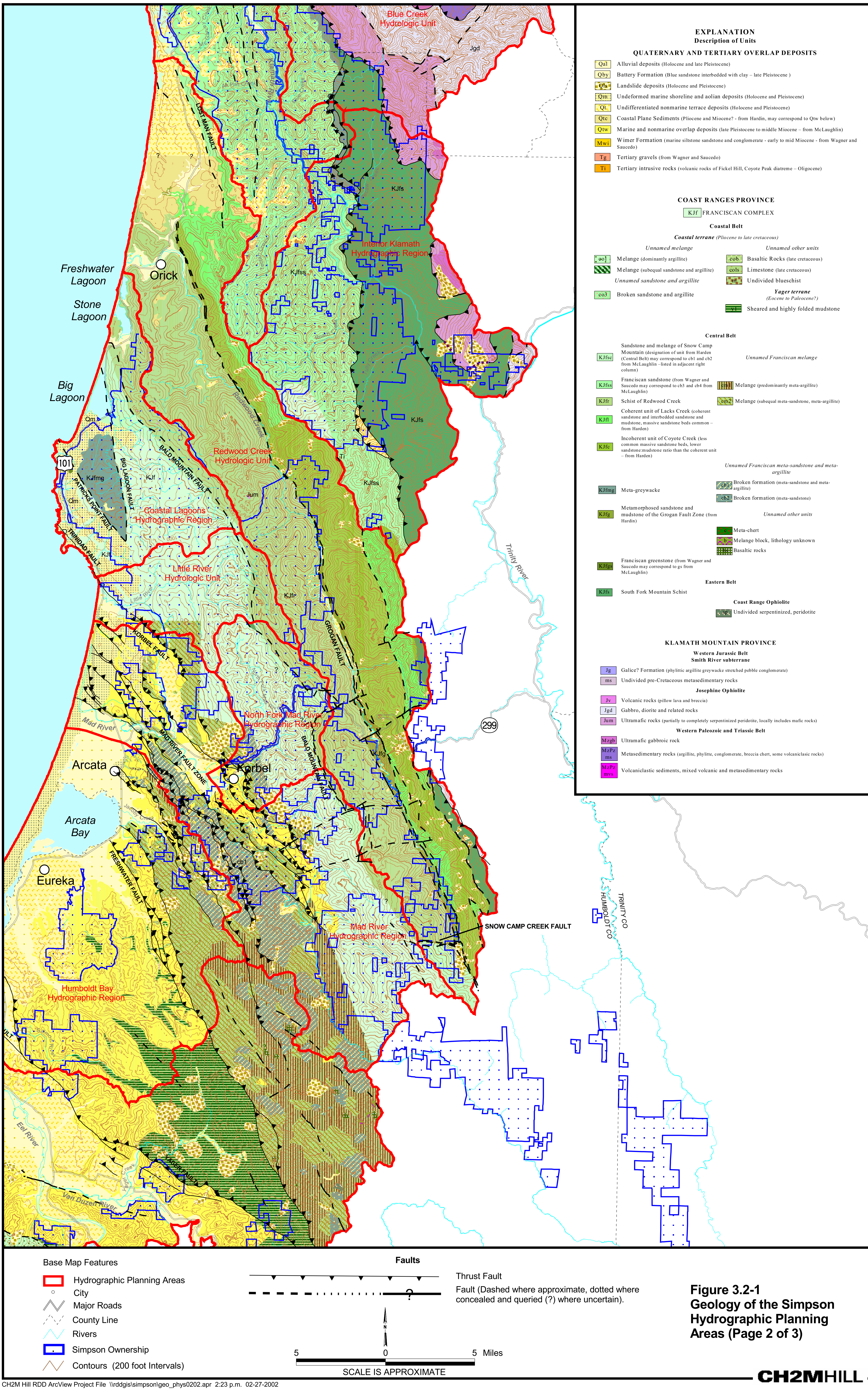

Figure 3.2-1
Geology of the Simpson Hydrographic Planning Areas (Page 2 of 3)

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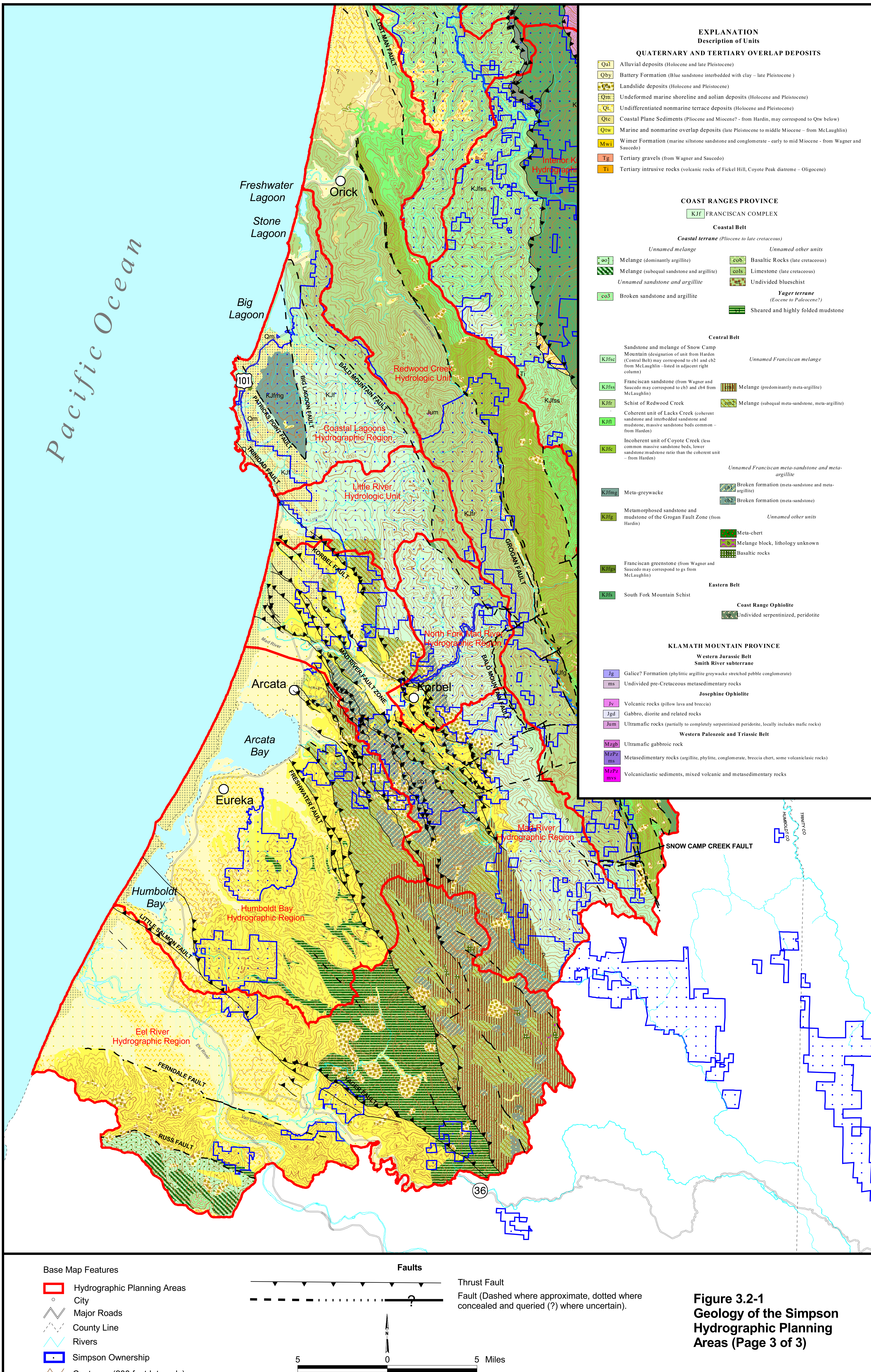

Figure 3.2-1
Geology of the Simpson Hydrographic Planning Areas (Page 3 of 3)

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The geology of the Klamath Mountains and Coast Ranges geologic provinces is described in greater detail in the sections below.

3.2.2.1 Klamath Mountain Province

At present, five major terranes of the Klamath Mountains are recognized, and several of these are subdivided into two or more geologic units. Each terrane is bordered by major faults that represent lines or sutures where plate fragments are joined (Harden, 1998).

A brief description of the rocks and terranes of the Klamath Mountains Province that underlie the Primary Assessment Area follows.

Western Jurassic Belt

The rocks of the Western Jurassic Belt underlie the eastern margin of the Primary Assessment Area. This belt represents the youngest accreted terranes within the Klamath Mountains Province. This belt includes the rock units of the Smith River subterrane (Galice Formation) as well as rocks that may be correlative with the Josephine Ophiolite.

- **Galice Formation.** The Galice Formation represents a long belt of metasedimentary rocks formed during the Jurassic period approximately 150 million years ago. The rocks of the Galice formation include marine slate (mildly slatey to phyllitic argillite), partially serpentinized peridotite, metagraywacke, stretched pebble conglomerate, and greenstone and metavolcanic Western Jurassic Belt breccia.

- **Josephine Ophiolite.** The Josephine Ophiolite represents a remnant of oceanic basement rocks that originated from a fragment of an oceanic plate that was thrust onto the North American continent during the Jurassic period. The rocks of the Josephine Ophiolite include, gabbro, pyroxinite, pillow basalt, serpentinite, and sequences of ultramafic rocks.

The Western Jurassic Belt also contains small pockets of intruded dioritic rocks that may be located within the Primary Assessment Area. To the west, the rocks of the Western Jurassic Belt are separated from the rocks of the Coast Ranges by a major fault (the South Fork Mountain Thrust fault).

Western Paleozoic and Triassic Belt

This belt is located to the east of the Western Jurassic Belt and has been subdivided into at least three separate geologic terranes. However, only one terrane (Rattlesnake Creek) occurs within the Primary Assessment Area.

- **Rattlesnake Creek Terrane.** The Rattlesnake Creek Terrane includes oceanic ultramafic rocks (i.e., gabbro), and metasedimentary rocks (i.e., argillite, phylitte, conglomerate and metachert) and vocaniclastic sediments and mixed volcanic and metasedimentary rocks.

In addition, the Western Paleozoic and Triassic Belt contains extensive intrusions of post-accretionary dioritic and pre-accretionary ultramafic-gabbroic plutonic rocks. However, it is uncertain if any of these materials occur within the Primary Assessment Area. The Western Paleozoic and Triassic Belt is primarily located along the eastern margin of the Smith River Hydrographic Unit and is separated from the Western Jurassic Belt by a complex network of thrust faults.

3.2.2.2 Coast Range Province

The majority of the Primary Assessment Area (greater than 80 percent) is located within the Coast Range Province (Figure 3.2-1). The rocks of the Coast Range represent oceanic crust that was accreted to the continent beginning in the mid-Jurassic period (approximately 140 million years ago). Similar to the Klamath Mountains Province, the assemblages of the Coast Range terranes are fault bounded and exhibit a sequential east to west accretionary pattern.

A brief description of the Coast Range terranes and associated rocks that underlie the Primary Assessment Area is presented below.

The Franciscan Complex

The Franciscan Complex includes three major belts (Eastern, Central, and Coastal). Cashman et al. (1995) and McLaughlin et al. (2000) describe the rocks of these belts and the geologic terranes in further detail. In general, the most abundant types of rock units found within these terranes consist of layered and interlayered sequences of marine sandstone (i.e., greywacke sandstone), schist, mélange, mudstone, shale, and other common rock types such as serpentinite, chert, and conglomerate, basalt and Coast Range ophiolitic rocks.

Because the Franciscan Complex includes rock units that vary greatly in lithology, structural style, and degree of metamorphism, the rocks in the complex are also described as belonging to a specific textural zone (Blake et al., 1967). It should be noted that some of the older geologic maps used to compile Figure 3.2-1 did not differentiate the various units and textural zones. Thus, unless a unit is specifically called out on the map, the textural zones listed below may be included in the areas mapped as Franciscan Complex (KJf) and Franciscan Complex Sandstone (KJfss).

The textural zones of the Franciscan Complex include the following:

- **Franciscan Mélange.** The Franciscan Mélange consists of discontinuous, resistant blocks of graywacke sandstone, chert, greenstone, and high-grade metamorphic rock in an intensely sheared, blue-gray shaley matrix. The texture of the unit may be related to mixing by either tectonic or sedimentary (mudslide) processes (Jordan, 1978).

- **Unmetamorphosed Franciscan Complex - Textural Zone 1.** Textural Zone 1 consists of fine-to coarse-grained graywacke sandstone with interbeds of siltstone, shale, and minor conglomerate. The rocks are olive to gray-green when fresh and weather to tan or gray-brown. Exposures are well-lithified and massive to thickly bedded. Subordinate rock types include chert, pillow basalt, and greenstone.

- **Semi-Metamorphosed Franciscan Complex - Textural Zone 2.** Textural Zone 2 consists of semi-schistose, lawsonite bearing graywacke sandstone and siltstone, similar to the rocks in Textural Zone 1. Platy foliation, visible in hand specimen, has developed, but original bedding is still present.

- **Undifferentiated Franciscan Complex.** Undifferentiated Franciscan Complex is mapped where the Franciscan has not been subdivided. It consists predominantly of fine- to coarse-grained dark gray to green graywacke sandstone and dark-gray shale. Subordinate amounts of red or green chert, conglomerate, pillow basalt, greenstone, and pods of serpentinized ultramafic rocks also occur within this unit.

- **South Fork Mountain Schist - Textural Zone 3.** The South Fork Mountain Schist is metamorphosed and sheared to the point where original bedding is no longer evident. The unit forms a sinuous belt of schistose metasedimentary and metavolcanic rocks next to the South Fork Fault, the unit's eastern boundary.

Overlap Assemblage

Sedimentary deposits that formed in a variety of marine to non-marine environments overlie the late Cenozoic to late Mesozoic accreted terranes of the Franciscan Complex. These deposits (the Late Cenozoic post-accretionary Overlap Assemblage) are partly similar in age to the Franciscan basement rocks. However, the rocks are considerably less deformed, unmetamorphosed, and less lithified than the rocks of the Franciscan Complex (McLaughlin et al., 2000).

The primary rock units that occur in the overlap assemblage within the Primary Assessment Area are represented by the formations of the Wildcat Group and, to a lesser extent, the Bear River beds (Figure 3.2-1). In general, the Wildcat Group consists predominantly of a sequence of weakly to moderately well lithified marine sandstone, siltstone, mudstone, and non-marine sandstones and conglomerates. The Wildcat Group overlies older basement rocks of the Franciscan Complex and middle rocks that have been assigned to the Bear River beds (interbedded siltstone, sandstone) (McLaughlin et al., 2000).

Other Quaternary and Tertiary Overlap Deposits

This section describes rocks that may occur within both the Klamath and Coast Range Provinces. These rocks include units of unconsolidated or weakly consolidated materials such as terrace deposits, alluvial and colluvial materials, coastal sediments, and unusual occurrences of post accretionary intrusive rocks (e.g., Coyote Peak diatreme).

- **Weathered Bedrock, Colluvium, and Soils.** An overlying mantle of weathered bedrock and colluvial deposits is ubiquitous in the Primary Assessment Area. Typically, the deposits are poorly consolidated, loose, and moderately to well drained. The material is usually thickest toward the axes of swales and drainages and thinnest on the steeper side slopes where it has been shed off by erosion and shallow landsliding. The composition and thickness of the colluvial deposits and associated soils is variable and is related to the makeup and slope gradient of the underlying bedrock.

  Thicker colluvium and soils typically reside in areas with gentle slopes where the bedrock is usually less indurated. Steeper slopes are generally covered by only a thin mantle (typically less than 3 feet thick) of colluvium. These slopes are usually underlain by hard, well-cemented materials (e.g., sandstone and siltstone), and the contact between the bedrock and colluvium is often sharp. The sharp contact is often accompanied by a permeability contrast between the two units that allows a seasonal perched water table to develop. The thin soil cover is a product of the inherent low rate of bedrock weathering and the steepness of the slope (which facilitates the shedding off of the unconsolidated surface material). The thin nature of the colluvial deposits overlying hard bedrock on the steeper slopes plays an important role in the style and distribution of shallow landslides and the potential effects of timber management.

- **Modern Alluvium.** Scattered concentrations of modern alluvium occur along stream beds and inner and upper floodplains throughout the Primary Assessment Area. The alluvial materials include boulders in creek bottoms, sand, pebbles and cobbly gravel in inner floodplains, and fine sand and silt loam in overbank deposits.

- **Stream Terrace Deposits.** Deposits of moderately to intensely weathered alluvium are scattered throughout the Primary Assessment Area. Mapable units have been noted in prominent terrace surfaces adjacent to Redwood Creek and remnants of former terrace deposits have been mapped on gently sloping hillslopes near Redwood Creek (Harden et al., 1981). Late Quaternary fluvial terraces are found along well developed major rivers such as the Mad, Eel, and Van Duzen rivers.
- **Coastal Plain Sediments.** Unconsolidated to weakly consolidated silts, sands, and gravels associated with minor amounts of organic-rich mud are located within the Primary Assessment Area along the coastal plain.
- **Landslide Deposits.** A number of landslide deposits and scars have been mapped within the Primary Assessment Area (Harden et al., 1981). Many of the more prominent landslides may be correlated to terranes underlain by fault zones and specific rock units (e.g., the Incoherent Unit of Coyote Creek in the Franciscan Complex).
- **Tertiary Intrusive Rocks.** The Central Belt of the Franciscan Complex contains limited occurrences of (alkalic) intrusive volcanic rocks of unusual mineralogical composition. These intrusive bodies correspond in age to the Oligocene epoch (approximately 35 million years before) and occur at two localities northeast of Arcata. One of these localities, known as the Coyote Peak diatreme, is located within the boundaries of the Primary Assessment Area.

3.2.2.3 Seismic Hazards, Faults, and Structural Relationships

Northern coastal California and the adjacent offshore area constitute one of the most seismically active areas in the state (Cashman et al., 1995). This entire area of northwest coastal California is subject to earthquakes on several onshore faults and falls within the Cascadia subduction zone, an area thought to be capable of great (magnitude 8 to 9) earthquakes (CDMG, 1996). The high level of tectonic activity in the region is also attributed to the proximity of the Mendocino triple junction (McKenzie and Morgan, 1969), an offshore boundary (located south of the Primary Assessment Area) which separates three major crustal plates and is the northern terminus of the San Andreas Fault (Figure 3.2-1).

Several moderately active crustal faults (e.g., the Little Salmon, Mad River, Trinidad, and Fickle Hill faults) are located near or within portions of the Primary Assessment Area. Faults that show evidence of recent (Quaternary) movement, and those faults that form the boundaries that separate the major belts, terranes, and subterranes of the Klamath Mountains and Coast Range Provinces are described below.

Although most of the faults strike northwest, they exhibit a range of orientations from shallowly dipping to vertical, and also represent different deformational episodes (Monsen et al., 1980, 1982). In addition, the orientations of the region's faults and geologic terranes often mark contacts between distinctly different rock units that, inturn, strongly influence area topography and drainage patterns. The faults that exhibit evidence of recent activity may also delineate potential geologic hazard zones (i.e., the occurrence of high ground accelerations resulting from earthquakes on nearby faults may directly or indirectly result in slope failures).

The following faults show no evidence of movement during the Quaternary period:

South Fork Fault

The South Fork Fault (Irwin, 1974), a major east-dipping fault, separates and thrusts the rocks of the Klamath Mountains over the rocks of the Eastern Franciscan Belt of the Coast Range Province. Serpentinite, and a zone of tectonically mixed rocks have been mapped in areas (e.g., in the Redwood Creek basin) immediately above the South Fork Fault (Young, 1978).

Indian Field Ridge Fault

The Indian Field Ridge Fault crops out to the west of the South Fork Fault and is marked in places by narrow zone of unmetamorphosed pervasively sheared rocks (Cashman et al., 1995).

Grogan Mountain Fault Zone

The steep northeast dipping Grogan Mountain Fault Zone delineates the channel of Redwood Creek. The zone is defined by an area of metamorphosed and pervasively sheared rocks and separates units of sandstone that mark distinct contrasts in surface topography (e.g., Incoherent Unit of Coyote Creek and Coherent Unit of Lacks Creek).

Bald Mountain Fault

The Bald Mountain Fault lies to the west of the Grogan Fault and separates unmetamorphosed sandstone and mélange units to the west from the metamorphosed units (schists) of the Grogan Fault zone to the east (Strand, 1962).

Snow Camp Creek Fault

The Snow Camp Creek Fault is the only major east-west trending fault in the Primary Assessment Area. The fault is located just south of Pardee Creek in the Redwood Creek basin and separates (Redwood Creek) schist units on the south from Franciscan sandstone and mélange units to the north (Harden et al., 1981).

The following faults exhibit evidence of recent movement and may be active:

Patricks Point Fault

The Patricks Point Fault is a northeast-dipping thrust fault located below the prominent raised marine terrace cut into the Falor and Franciscan rocks at Patricks Point. The terraces are interpreted to record fault bend folding of the hanging wall of a deeply buried thrust above the fault. The length of the inclined segment of the Patricks Point terrace is about 2 kilometers (km). The fault bend fold model predicts this length should correspond with the total accrued slip on the buried fault (i.e., about 2.4 centimeters per year) (Carver and Burke, 1989).

Mad River Fault Zone

The Mad River Fault Zone is a major zone of complex southwest-verging thrust faults located in the vicinity of the Mad River northeast of Arcata Bay. There are five principle faults in the Mad River Fault Zone including the Trinidad, Blue Lake, McKinleyville, Mad River, Fickle Hill, and numerous minor thrustfaults (e.g., Korbel and Falor Faults). The faults of this zone have been shown to displace strata in the late Pleistocene to Holocene Age (less than 2 million years) and are thus active (McLaughlin et al., 2000).

Freshwater Fault

The Freshwater Fault is an east-dipping, high-angle reverse fault that decreases in dip to the north. Movement on this fault was thought to have preceded Wildcat deposition

(Ogle, 1953), but recent studies show it to offset the Wildcat, suggesting late Cenozoic reactivation (Woodward-Clyde Consultants, 1980).

Little Salmon Creek and Yager Faults

The Little Salmon Creek Fault is a moderately low-dipping southwest thrust fault located in the central Eel River basin south of Eureka. The fault zone cuts the surface and displaces Holocene (recent) Age strata. The nearby Yager Fault is interpreted to root in the same zone of thrusting as the Little Salmon Creek Fault (McLaughlin et al., 2000). Data on slip rate and estimates on earthquake recurrence intervals indicate that the Little Salmon Fault is active and capable of generating large earthquakes.

Russ and False Cape Fault Zones

The Russ Fault Zone juxtaposes Miocene and younger strata (less than 24 million years) of the Eel River forearc basin (i.e., overlap assemblage) with coeval and older strata of the underlying accretionary complex. The distribution of surface and subsurface earthquakes strongly suggest that the Russ Fault is active at shallow depths (McLaughlin et al., 2000).

3.2.3 Geomorphology

3.2.3.1 Landform Development

The topography of the Primary Assessment Area is highly variable and consists of landforms ranging from steep terrane with deeply incised narrow drainages, to rolling landscape with less deeply incised drainage networks. As noted, the region has experienced high rates of Neogene uplift, deformation, and accompanying channel down cutting. Parallel to these processes, the area has experienced relatively high denudation rates and the upper reaches of many drainages have been sculpted over geologic time by repeated shallow landslides. At present, landslides are common throughout the Primary Assessment Area and continue to be a major force shaping the modern landscape.

In addition to hillslope mass wasting and erosional processes, a dominant factor controlling the variation in topography is the underlying rock mass and associated geologic structure. According to McLaughlin et al. (2000), rock masses larger than a few hundred meters in diameter tend to develop topographic forms related to the erosional and slope-stability properties of the constituent materials. These properties may be controlled by many factors, such as the structural state of the rock mass and orientation of layering. Rates of tectonic uplift may also play a role in the development of topographic form. However, geodetic work indicates that these rates tend to vary gradually and impact broad regional areas, rather than more localized areas (e.g., subunits of specific rock terranes located within individual HPAs) (McLaughlin et al., 2000).

The spatial variation in dominant rock units or geologic groups in the HPAs is evident in the expression of the local topography. In addition, the contact between the rock units and overlying soil is gradational and varies according to rock unit and topography. The major rock types and associated soils and landforms that may be found in the Primary Assessment Area follow.

- Sandstone rock masses weather to granular (sandy and silty) soil that is stable enough to form steep slopes. The stability and homogeneity of such soils and rock masses tend to result in steep, sharp-crested topography dissected by a regularly spaced array of straight, well-incised sidehill drainages (McLaughlin et al., 2000).

- Units containing unconsolidated and poorly indurated sandstone rock masses rapidly weather when disturbed and are highly unstable. These units tend to form a thick cover of sandy and silty soils, support only gentle hillslopes and poorly incised sidehill drainages, and crests tend to be rounded (Bond. J, NMFS, pers. comm.).
- Highly folded broken formations that also include zones of clayey sheared argillitic rock generally correspond to steep topography with generally sharp crests and well-incised but irregular sidehill drainages (McLaughlin et al., 2000).
- Units containing mélange with subequal amounts of sandstone and argillite or units that are predominantly made up of argillitic sequences that are highly folded and variably sheared generally have irregular, gently to moderately sloping topography that lacks a well-incised system of sidehill drainages (McLaughlin et al., 2000). Mélange areas typically support grassland prairie zones, which are susceptible to gully erosion, especially where overgrazing has increased runoff and road construction has disturbed the natural drainage channels. Although commercial timber grows on land underlain by mélange, many such areas were converted to grassland after timber harvesting and have not produced new timber growth (CDWR, 1982).
- Clayey rock masses, especially where sheared, weather to clayey soil materials. These clayey soils and bedrock are so weak that they can support only gentle hillslopes and poorly incised sidehill drainages, and crests tend to be rounded (Kelsey et al., 1995; McLaughlin et al., 2000).
- Well-indurated rock masses associated with the terranes of the Klamath Mountains Province result in very steep, sharp-crested topography. These units are typically overlain by thin soils and are dissected by straight, well-incised sidehill drainages.

3.2.3.2 Soils

The following section provides a brief description of the main soils types (series) in the Primary Assessment Area and is intended to supplement the geologic and geomorphologic descriptions presented above by providing additional background on how different soil series may relate to hillslope mass wasting and erosion in the region.

Soil is the product of the action of the climate and living organisms upon the parent material, as conditioned by time and relief. The interrelationships among the factors of soil formation are complex, and the effect of any one factor cannot be isolated and identified with certainty. Soils also have many characteristics that affect their behavior and response to various land uses. Specific physical and chemical properties such as permeability, susceptibility to erosion, and other features such as location of the water table, depth to bedrock, underlying geology, and slope influence how certain soils will react to various land management practices.

A soil survey is an inventory and evaluation of the characteristics and properties of soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. The descriptions presented in this section are based on

U.S. Department of Agriculture, Soil Conservation Service (SCS) soil surveys conducted in 1921, and CDF Soil and Vegetation Survey maps published in 1975. The information provided in the CDF soil-vegetation association maps is based on aerial photographs with limited ground truthing. Because much of the soil information in the Primary Assessment Area is out of date or incomplete, more comprehensive and up-to-date soil survey work is currently being conducted by the Natural Resource Conservation Service (NRCS), the successor to the SCS. However, this work is ongoing and the most recent NRCS soil survey data is not available at this time.

Area geology, along with the influence of climate, vegetation, and topography, resulted in the formation and distribution of a large number of different soil series within the Primary Assessment Area. This section, however, only presents descriptions of those soil series that have the largest aerial coverage in the Primary Assessment Area. Information on other less dominant soil series in the Primary Assessment Area is not provided due to the smaller total acreage covered by the series, discontinuity in area the soils cover, or incomplete soil information.

Six predominant soils series within the Primary Assessment Area are Hugo, Masterson, Melbourne, Larabee, Josephine, and Atwell. The remaining soils include those soils that are either unmapped or cover smaller discontinuous sections of the Primary Assessment Area.

The soils classification descriptions provided by NRCS and other agencies further define soils series descriptions according to physical and chemical properties including factors such as the following:

- Parent material the soil is derived from
- Texture
- Organic matter content
- Moisture retention characteristics
- Color
- Depth
- The type of terrane (slope) where the soil is found
- The soil’s surface erosion hazard rating

A summary of the physical and chemical characteristics of the predominant soils series in the Primary Assessment Area is presented below.

Hugo

Hugo soils are gray-brown at the surface, pale brown at the subsurface, and are 30 to 60 inches deep. The Hugo series consists of deep, well drained soils that formed in material weathered from sandstone, shale, schist, and conglomerate. Hugo soils are on uplands and occur on strongly dissected mountains with sharp, narrow ridges, and deep V-shaped drainages and have slopes of 9 to 75 percent. They range from near sea level to 4,000 feet elevation (NRCS, 1998). They range in texture from loam to clay loam. Surface erosion hazard is moderate to high (University of California, 1979). Hugo soils are associated with Melbourne soil and they are found throughout the Primary Assessment Area.

Masterson

According to the NRCS, Masterson soils are located on rolling to steep slopes at elevations of about 5,000 to 6,500 feet. However, Masterson soils are located at lower elevations in the Primary Assessment Area. The soils are dark brown at surface changing to yellow brown closer to bedrock. They formed in residuum weathered from mica schist and their depth to bedrock ranges from 20 to 40 inches (usually 30 to 40 inches). The amount of coarse fragments increases with increasing depth below a depth of 10 inches and average 35 percent to 55 percent of the volume. (NRCS, 1998). Masterson soils are most abundantly found in the Redwood Creek and Interior Klamath HPAs.

Melbourne

Melbourne soils are on foothills, hillsides, and ridge tops at elevations of 200 to about 1,200 feet. Slopes are zero percent to 65 percent. The soil formed in residuum colluvium from siltstone and fine-grained sandstone (NRCS, 1998). Melbourne soils are brown at the surface, dark brown in the subsurface, 30 to 60 inches deep, and are classified as loam to clay loam. Surface erosion hazard is moderate on slopes less than 50 percent (University of California, 1979). Melbourne soils are associated with Hugo soils and they are found throughout the Primary Assessment Area.

Larabee

Larabee soils occur on moderately steep to steep, well dissected uplands under forest vegetation at elevations up to 2,000 feet. Larabee soil is typically deep, well drained, and fine grained, with a high silt content throughout the profile. Larabee soil is derived from soft sedimentary rocks of the California north coast range and is found mostly within the Mad River, Humboldt Bay, and Eel River HPAs.

Josephine

The Josephine series consists of deep, well drained soils (gravelly loam) that formed in moderately fine textured colluvium and residuum weathered from sedimentary, metamorphosed sedimentary, and volcanic rocks. Josephine soils are on broad ridge tops, toeslopes, footslopes, and side slopes of mountains. Elevations are 200 to 5,500 in California. Slope gradients dominantly are 35 percent to 60 percent but range from 2 percent to 75 percent. Josephine soils can be found to a depth of 59 inches and range from dark brown at surface to brown, reddish brown and yellowish brown at depth (NRCS, 2000).

Atwell

Atwell soils are important because they are extremely erodible (University of California, 1979). These soils formed in colluvium from sheared graywacke sandstone and shale. Atwell soils occur in mountainous terrane at elevations up to 3,000 feet. They occupy concave to irregular, unstable slopes in areas of high drainage density. Soil slips, landslides, seeps, and springs are common in Atwell soils. Slope gradients are from 15 percent to 50 percent and colors vary from grayish brown, to dark grayish brown and olive brown to light yellowish brown (NRCS, 2001). Atwell soils are known to occur in association with the Mad River Fault Zone and the Grogan Fault (Redwood Creek), and they likely occur in other localities of the Primary Assessment Area as well.

3.2.3.3 Landslide Classification and Landslide Prone Terrain

Many types of hillslope mass wasting occur within the Coast Range and Klamath Mountain Provinces. As previously mentioned, landslides are common throughout the Primary Assessment Area. Intense and prolonged rainfall events combined with area geology, geomorphology, and timber harvesting activities often result in conditions that are highly susceptible to excessive erosion and landslides, especially when high antecedent groundwater conditions exist. Types of landslides in the Primary Assessment Area are described below based on the classifications in Crunden and Varnes (1996) and CDMG (1997) with modifications to suit the conditions present in the area.

Shallow-Seated Landslides

Shallow-seated landslides are generally confined to the overlying mantle of colluvium and weathered bedrock, although in some instance may involve competent bedrock as well. Most shallow landslides are rapid events and commonly leave a bare unvegetated scar after failure.

- **Debris Slides.** Debris slides are characterized by a process whereby unconsolidated rock, colluvium, and soil have failed rapidly along a relatively shallow failure plane. In most instances the depth of failure is less than 10 feet. In some instances, however, a debris slide may extend deeper and incorporate some of the underlying competent bedrock. Debris slides often form steep, unvegetated scars in the head region and irregular, hummocky deposits in the toe region. Slide debris often overrides the ground surface near the toe. Debris slides may exist individually or coalesce to form a larger landslide complex. Slides often continue to move for several years following initial failure. Most natural debris slides are triggered by elevated pore water pressures resulting from high intensity and/or long duration rainfall or from being undercut by stream erosion. The occurrence of high ground accelerations resulting from earthquakes on nearby faults may also result in shallow slope failures either directly or indirectly by reducing soil strength and altering the groundwater regime. In many managed watersheds, a common cause of debris slides is thick, over-steepened road fill associated with old roads, skid trails, and landings.

- **Debris Flows/Torrents.** Debris flows and debris torrents are characterized by long stretches of bare soil and generally unstable channel banks that have been scoured by the rapid movement of debris. Failure typically begins as a debris slide but quickly mobilizes into a flow or torrent as material liquefies, traveling rapidly downslope. These landslides occur most commonly on very steep slopes at or near the axis of small swales or stream channels. As a debris flow/torrent moves through first and second order channels, the volume of material may increase to a much greater size than the initial failure. It is not unheard of for a large debris torrent to deliver more than 10,000 cubic yards of sediment to a stream channel.

- **Channel Bank Failures.** Channel bank failures are defined as small shallow debris slides that occur along the banks of stream channels. Such failures are a result of undercutting of the stream bank by stream incision or stream widening. Large channel bank failures that extend far up an adjacent hillslope may become difficult to distinguish from debris slides. Because such failures are relatively common along streams they have been classified separately from the other failures.

- **Rock Falls.** Rock falls are characterized by catastrophic failure of relatively steep rock slopes or cliffs along a surface where little or no shear displacement takes place. Generally rock debris accumulates at the toe of the slope. Rock falls are relatively uncommon in the Primary Assessment Area.

Deep-Seated Landslides

Deep-seated landslides typically have a basal slip plane that extends into bedrock. Most deep-seated failures move incrementally; catastrophic failure is relatively rare. Active slides are typically vegetated with trees and/or grass.

- **Translational/Rotational Rock Slides.** Translational/rotational rockslides are characterized by movement of a relatively intact slide mass with a failure plane that is relatively deep when compared to that of a debris slide. The slide plane typically extends below the colluvial layer into the underlying and more competent bedrock. The slides often have a distinct toe at the base of the hillside and undercutting of the toe of the slope by streams plays a key role in their long-term stability. Translational/rotational rock slides are identified by a broad arcuate headscarp and a series of mid-slope benches on what is otherwise moderately to steeply sloping terrane. Sag ponds, hummocky topography, and springs and patches of wet ground may be present. Commonly the landslide consists of several smaller slide blocks that coalesced together to form the larger landslide complex. Lateral scarps between the individual landslide blocks are often poorly defined, in part due to the low rate and/or infrequent movement of the slide mass. Differential movement between individual slide blocks is common. Where slide movement is most active, drainage networks and stream channels are shallow and generally poorly to moderately defined. Movement is most apparent in the upper portion of the hillside and less apparent near the toe. Steep main scarps, secondary internal slide scarps, and toe slopes may be subject to debris sliding.

- **Earthflows.** Earthflows are characterized by a relatively large semi-viscous and highly plastic mass resulting in a slow flowage of saturated earth. Most earthflows are composed of a heterogeneous mixture of fine-grained soils and rock. Earthflows may range from less than 1 acre to hundreds of acres. The depth of failure is varied but typically greater than 15 feet and the degree of activity is varied - many earthflows are dormant while others exhibit seasonal creep in response to high rainfall. Rapid movement of such failures is rare. Ground displacement is generally slight, and catastrophic failure of the slope is unlikely. Slide materials erode relatively easily, resulting in gullying and irregular drainage patterns and may be reactivated in response to removal of toe support, high rainfall events, and possibly by large seismic events. Because of the seasonal movement associated with some of these slides, earthflow areas are often unable to support timber stands. Small earthflows may be influenced by poor road drainage across the toe of the slide.

Landslide-Prone Terrains

Both deep and shallow landslides occur within the Primary Assessment Area, with shallow landslides most common on slopes steeper than 60 percent to 70 percent. In general, steep streamside slopes, inner gorge slopes, steep headwall swales, and breaks-in-slopes have been identified as areas with greater potential for producing shallow landslides compared to adjacent slopes. Landslides are also more frequent in areas of convergent slope form where surface and ground waters tend to concentrate and where colluvial soils tend to be thickest.

The most prevalent landslide-prone terrains in the Primary Assessment Area are:

- **Steep Streamside Slopes.** Steep streamside slopes are defined as steep slopes located immediately adjacent to a stream channel, and generally formed, over time, by coalescing scars from shallow landsliding and stream erosion. These slopes typically exceed 65 percent gradient where stream incision has undercut the toe of the slope, and descend directly to streams without intervening topographic benches. Preliminary landslide inventories in the Primary Assessment Area indicate that roughly 60 percent to 90 percent of all shallow landslides initiate on steep streamside slopes. All steep streamside slopes show evidence of modern landslide processes (less than 50 years old) when slopes are examined on a sub-basin level.

- **Inner Gorges.** An inner gorge is a subset of steep streamside slopes where a more-or-less distinct break-in-slope separates steeper “inner gorge” slopes below the break-in-slope from lower gradient slopes above the break. The steep streamside slopes classification includes inner gorge slopes as well as those steep slopes where a distinct break-in-slope is absent.
- **Headwall Swales.** Many shallow landslides occur within headwall swales upstream of Class III watercourses, where convergent topography forces both the accumulation of thick soils and the concentration of shallow subsurface runoff along the axis of the valleys. Headwall swales are defined as areas of narrow, steep, convergent topography (swales or hollows) located at the heads of Class III watercourses (i.e. an unchanneled swale extending upstream of a watercourse) that have been sculpted over geologic time by repeated debris slide and debris flow events. The sideslopes leading into the swale are typically greater than 70 percent. Slopes are often smooth to slightly irregular, unbroken by benches. Swales often have an inverted teardrop or spoon shaped appearance. Seasonal seeps, springs and wet areas may exist within the axis of the swale toward the base. The soil and colluvium depth is often much deeper within the axis of the swale than on the adjoining side slopes. The surface expression of the swale may be distinct to subdued. The width of headwall swales is highly variable ranging between 30 and 100 feet.

3.2.4 Geology, Topography, and Geomorphology of the HPAs and Rain-on-Snow Areas

This section provides a brief description of the geology, topography, and geomorphology of the 11 HPAs. This general information is provided because more detailed and specific information on the individual HPAs is not available at this time. Simpson is in the process of conducting a Hillslope Mass Wasting Assessment and Landslide Inventory on its fee-owned lands within the Primary Assessment Area. The assessment is currently scoped as a 5-year effort and the resulting data will be used to fill in the gaps on site geology and hillslope mass wasting within the individual HPAs. HPAs encompassing complete drainage areas are referred to as hydrologic units, whereas those encompassing partial or multiple watersheds are referred to as hydrographic regions.

3.2.4.1 Smith River Hydrographic Region

The Smith River Hydrographic Region is approximately 182,000 acres. Bedrock underlying the hydrographic region predominantly consists of Central Belt Franciscan Complex rock with areas of Klamath Mountains bedrock along the eastern margin of the region. Faults in the region include the inactive South Fork Fault, which separates the Franciscan bedrock from the Klamath Mountains bedrock, and a complex network of thrust faults within the Klamath Mountains geology.

Scattered, poorly consolidated remnants of Miocene marine sandstone, siltstone, and conglomerate deposits (Wimer Formation) overlie the Franciscan bedrock on ridges, approximately 5 miles inland and at elevations of 1,200 to 1,600 feet above mean sea level (ASL). There are also remnants of continental deposits of sandstone and conglomerate, of similar age, on ridges at slightly higher elevations, near the Wimer Formation deposits. The coastal section of the hydrographic unit is dominated by the Smith River Plain, an elevated marine terrace where an abrasion platform of Franciscan rocks is almost entirely covered with a blanket of marine siltstone, shale and unconsolidated sands of Pliocene and Pleistocene age (Battery Formation). Pleistocene to Holocene river terrace deposits, flood plain deposits, and dune sands also cover large portions of the Smith River Plain. Unconsolidated Pleistocene to Holocene river terrace and flood plain deposits can also be found at various locations along stream and river channels (Ristau, 1979; Davenport, 1982-84; Wagner and Saucedo, 1987) within the unit.

Within this HPA, Central Belt Franciscan bedrock composed of Undifferentiated Franciscan Sandstone underlies Simpson's northern and southwestern ownership and Klamath Mountains bedrock composed of serpentinite, gabbro, metavolcanics, and metasedimentary rocks underlies the southeastern ownership (Figure 3.2-1).

The topography of the Smith River Hydrographic Region is highly variable, but, in general, is relatively steep and sharp-featured compared to other HPAs. Pleistocene and Holocene landslide deposits cover portions of the Franciscan bedrock at numerous locations. Published landslide maps indicate that both shallow and deep-seated landslides exist throughout this HPA with debris slides and disrupted ground present on many of the steeper slopes (CDMG, 1999). The inherently weak serpentinite of the Klamath Mountains bedrock is also particularly prone to landslide processes, but this geologic unit is only a small portion of the Primary Assessment Area in this hydrographic region.

3.2.4.2 Coastal Klamath River Hydrographic Region

The Coastal Klamath River Hydrographic Region is approximately 108,000 acres. The area is predominantly underlain by Central Belt Franciscan Complex bedrock with Klamath Mountains bedrock underlying a narrow strip along the eastern margin of the unit. The Central Belt Franciscan Complex is generally described as meta-sandstone. Klamath Mountains bedrock in the HPA is composed of Josephine Ophiolite intrusive and extrusive volcanics, which includes partially to completely serpentinized ultramafic rocks, gabbro, diorite, pillow lava and breccia. The inactive South Fork Fault separates the Franciscan rocks from the older rocks of the Klamath Mountains geologic province (Figure 3.2-1).

The topography of the Coastal Klamath Hydrographic Region is highly variable, but in general is relatively steep and sharp featured. Landslide processes in the unit are dominated by shallow debris slides and debris flows, based on Simpson's preliminary landslide inventory data from this area. These landslides tend to be prevalent on steep streamside slopes along Class I and Class II watercourses and to a lesser extent in the headwall areas of Class III watercourses. Sediment delivered to watercourses from shallow landslides is considered a significant portion of the sediment budget for this hydrologic unit. Deep-seated landslides are relatively uncommon within this unit, although they do exist, as is indicated by CDMG-published landslide maps and Simpson's preliminary landslide inventory data. The inherently weak serpentinite of the Klamath Mountains bedrock is particularly prone to landslide processes, but this geologic unit comprises only a small portion of the Primary Assessment Area in this HPA.

3.2.4.3 Blue Creek Hydrologic Unit

The Blue Creek Hydrologic Unit is approximately 80,000 acres. The majority of the Blue Creek Hydrologic Unit (i.e., the central and eastern areas of the unit) is underlain by Klamath Mountains bedrock. The bedrock in the remaining sections of the unit (i.e., the southwest area of the unit) primarily consists of Franciscan Complex rocks (Figure 3.2-1). The inactive South Fork Mountain Fault separates the Coast Ranges Province from the Klamath Mountains Province.

The Primary Assessment Area within the Blue Creek Hydrologic Unit is primarily underlain by Franciscan Complex rocks. From east to west, bedrock within the hydrologic unit consists of small patches of partially to completely serpentinized ultramafic bedrock of the Josephine Ophiolite, the South Fork Mountain Schist unit of the Franciscan Eastern Belt and the meta-sandstone and mudstone of the Franciscan Central Belt.

The topography of the Blue Creek Hydrologic Unit is generally characterized by steep to very steep terrane, and is similar to the steeper topography within the Coastal Klamath HPA. Elevations and slope gradients increase toward the east of the unit due to higher concentrations of massively bedded Franciscan Complex sandstone, and the occurrence of the more resistant metasedimentary and ultramafic rocks of the Klamath Mountains.

Specific data on landsliding in this hydrologic unit is unavailable at this time. However, based on an analysis of existing geologic maps, it appears that landslide processes in this hydrologic unit are dominated by shallow debris slides and debris flows in the Klamath terranes, and there is a potential for deep-seated landslides within Coast Range terranes.

3.2.4.4 Interior Klamath River Hydrographic Region

The Interior Klamath River Hydrographic Region is approximately 128,000 acres. Bedrock in the region is primarily composed of the Coast Ranges Franciscan Complex, with Klamath Mountains bedrock present in limited areas at the eastern margin of the region. The inactive Coast Ranges Fault separates Franciscan Complex Central Belt sandstone from Franciscan Complex Eastern Belt South Fork Mountain Schist, and the inactive South Fork Fault separates the Coast Ranges Province from the Klamath Mountains Province geology.

Most of the Primary Assessment Area within this HPA is underlain by the Franciscan Complex bedrock. The bedrock in this HPA is roughly divided between Central Belt sandstone and Eastern Belt South Fork Mountain Schist. Central Belt meta-graywacke is also located in smaller areas of the HPA, and limited areas of the eastern margin of the region are underlain by Klamath Mountains volcanics and metavolcanics.

Specific data on landsliding in this hydrographic region is unavailable at this time. However, based on an analysis of existing geologic maps, it appears that landslide processes in this hydrographic region are dominated by shallow debris slides and debris flows in the Klamath terranes, and there is a potential for deep-seated landslides within Coast Range terranes.

3.2.4.5 Redwood Creek Hydrologic Unit

Substantial geologic mapping and research has been done in the Redwood Creek area (Nolan et al., 1995). As a result, the geology, landform development, and hillslope mass wasting characteristics of this hydrologic unit are probably the best understood of all of the HPAs that make up the Primary Assessment Area.

The Redwood Creek Hydrologic Unit is approximately 188,000 acres. The Redwood Creek Hydrologic Unit is located entirely within the Coast Ranges geomorphic province. Most of the Primary Assessment Area in this unit is underlain by the Redwood Creek Schist. Much smaller sections of the Primary Assessment Area, located to the east and southeast, are underlain by the Incoherent Unit of Coyote Creek, and the Coherent Unit of Lacks Creek. A small section located at the southern tip of the hydrologic unit is underlain by the Sandstone and Mélange of Snow Camp Mountain. Coastal plain and marine terrace sediments are located in the northern coastal area of the unit. These sediments are mainly composed of unconsolidated to slightly consolidated sands, silts, and gravels, and may be as much as 300 feet thick.

Each of the major bedrock units in the Redwood Creek Hydrologic Unit are set apart from one another by a series of major northwest trending faults. The most notable of the faults found in this unit is the Grogan fault, which defines the channel of Redwood Creek and separates the Redwood Creek Schist from the Incoherent Unit of Coyote Creek. Other notable faults are the Indian Field Ridge Fault, which separates the Incoherent Unit of Coyote Creek from the Coherent Unit of Lacks Creek, and the Snow Camp Creek Fault, located at the southern tip of the hydrologic unit, which separates Redwood Creek Schist from the Sandstone and Mélange of Snow Camp Mountain.

Many hillslopes in the Redwood Creek basin are unstable and highly susceptible to mass-movement failure because of the steepness of the terrane and the low shear strength of much of the underlying saprolite and residual soil. (This is especially true in the Incoherent Unit of Coyote Creek, although shallow landslides also exist in the unit). According to Colman (1973), at least 36 percent of the basin shows landforms that are the result of active mass movements or that are suggestive of former mass-movement failures. Complex associations of rotational slumping, translation, and earthflows are the most visually obvious forms of mass movement in the Redwood Creek basin. Some have clearly defined margins, but many gradually merge with less active areas of soil creep. On many earthflows, grass, grass-bracken-fern, and grass-oak prairie vegetation dominate in marked contrast to the mature coniferous forest or cutover land on more stable slopes.

Several lithologies occur within the Redwood Creek Schist and the geomorphic expression of the different schist units is variable. Slopes underlain by the Redwood Creek Schist have gently convex profiles and side-slope gradients commonly range from 20 percent to 40 percent. Both the Redwood Creek Schist and the South Fork Mountain Schist exhibit knobby topography in areas where greenstone units of tectonic blocks are included in the schist. Shallow, incised streams are a typical drainage feature of schist slopes (Cashman et al., 1995). In addition, some evidence of deep-seated, slow moving, landslide deposits have been identified in road cut exposures in the schist units (Cashman et al., 1995).

The sandstone and mudstone of the Coherent Unit of Lacks Creek have a distinct geomorphic expression. Sharp ridges, steep slopes, and narrow V-shaped tributary canyons are characteristic of the landscape developed on these relatively resistant rocks. Slopes have straight to gently concave profiles, and slope gradients commonly range from 30 percent to 50 percent. In the Coherent Unit, streamside debris slides and debris avalanches are common in the inner gorges of tributaries (Cashman et al., 1995). In contrast to the steep terrane of the Coherent Unit, the bedrock of the Incoherent Unit of Coyote Creek forms a subdued rolling landscape having less deeply incised drainage networks and few high points and knobs formed by resistant rock types. Earthflows are preferentially developed in this unit, as are streamside debris slides along inner gorges.

Rocks in the Grogan Fault Zone that are intermediate in texture and degree of metamorphism between the Redwood Creek Schist and the sandstone and mudstone units. The geomorphic expression of this unit is similar to that of the Incoherent Unit of Coyote Creek, and streamside debris slides are concentrated along linear zones of sheared rocks parallel to the Grogan Fault (Harden et al., 1981).

The landscape developed on the Sandstone and Mélange unit of Snow Camp Mountain is generally more hummocky than other hillslopes in the Redwood Creek Hydrologic Unit. However, parts of the Snow Camp Mountain unit are underlain by massive sandstone and display steep slopes, prominent ridges, and V-shaped valleys, in contrast to the more rolling hummocky hillslopes underlain by mélange. Tectonic blocks of greenstone and chert form prominent knobs and summits (Cashman et al., 1995). As in the Coherent Unit of Lacks Creek, streamside debris slides and debris avalanches are common in the inner gorges of tributaries and in the steeper areas of the unit underlain by massive sandstone.

3.2.4.6 Coastal Lagoon Hydrographic Region

The Coastal Lagoons Hydrographic Region is approximately 54,000 acres. Bedrock in the region includes the Redwood Creek Schist, the Sandstone and Mélange of Snow Camp Mountain, and Undifferentiated Central Belt Franciscan Mélange, the Patrick’s Point meta-graywacke unit, and younger marine and non-marine terrace deposits near the coastline.

These geologic units are generally structurally bounded by northwest trending thrust faults and high angle faults. Broad northwest trending anticlines and synclines are also mapped within the hydrographic region.

The topography of the hydrographic region is moderately steep, except in the younger terrace deposits and in the area of the lagoons near the coastline. Preliminary Simpson landslide inventory results indicate that both shallow and deep-seated landslides exist throughout the Coastal Lagoons hydrographic region.

3.2.4.7 Little River Hydrologic Unit

The Little River Hydrologic Unit is located within a coastal watershed with a drainage area of approximately 30,000 acres. From east to west, the bedrock of the unit is composed of Redwood Creek Schist (along the eastern margin), Sandstone and Mélange of the Snow Camp Mountain, and Undifferentiated Central Belt Franciscan Bedrock. Quaternary deposits are found near the mouth of the watershed located at Moonstone Beach (several miles south of Trinidad, California). The Snow Camp Mountain geologic unit is composed of hard, intensely folded graywacke sandstone and siltstone that grades into sheared mélange. The Redwood Creek Schist is mostly composed of hard, fine-grained quartz-mica schist, which includes or grades locally into bodies of semi-schist, slate, meta-conglomerate, and meta-chert (Kilbourne, 1983-85; Harden et al., 1981). The Undifferentiated Central Belt is composed of sandstone and mudstone. The Quaternary deposits are composed of poorly consolidated interbedded clays, silts, sands, and gravels.

Marine terrace deposits of late Pleistocene and Holocene Age cover bedrock surfaces on wave-cut benches, within about 3 miles of the coastline, and up to 500 feet ASL, near the mouth of Little River. The terrace deposits are composed of unconsolidated to slightly consolidated silts, sands, and gravels, including old dune sands. Holocene alluvium and flood plain deposits cover the valley floor, nearly one-mile wide, in the area downstream from Crannell (Ristau, 1979; Kelley, 1984).

The inactive Bald Mountain Fault is located between the Snow Camp Mountain and Redwood Creek Schist geologic units and the active Trinidad Fault separates these relatively young strata from the adjacent Franciscan Mélange.

The hydrologic unit is generally characterized by moderate- to high-relief hillslopes, except for the area from the Crannell town site to the mouth of the river at Moonstone Beach. Published landslide maps and Simpson's preliminary landslide data indicate that both shallow and deep-seated landslides exist throughout this HPA. The Franciscan mélange is particularly susceptible to earth flows, and the younger, sandy bedrock, which is susceptible to slumping and rotational slide movement, is relatively highly erodible.

3.2.4.8 Mad River Hydrographic Region

The Mad River Hydrographic Region is approximately 120,000 acres. Bedrock within the Mad River Hydrographic Region is composed mostly of Central Belt Franciscan Complex and Quaternary – Tertiary Overlap deposits juxtaposed by the Mad River thrust fault system. The Primary Assessment Area within this hydrographic region is composed of the three major geologic units mentioned above.

Topography in the region is relatively steep and mountainous, but fairly extensive lowlands are present from the mouth of the river and upstream to the Mad River Fish Hatchery, near the town of Blue Lake.

Central Belt Franciscan Complex is composed of broken formation (schist, greywacke sandstone, shale, conglomerate, chert, pillow basalt, and greenstone) and mélange (primarily composed of discontinuous bodies of hard greywacke sandstone, chert, greenstone and pillow basalt in a weak, pervasively sheared claystone matrix). However, mapping of the units has not been systematic and consistent in all parts of the watershed. In much of the area, the Franciscan units have not been separately identified, and the rock is simply mapped as Undifferentiated Franciscan.

Quaternary – Tertiary Overlap deposits include the Falor Formation, which is generally described as poorly cemented clay, silty clay, and pebbly sandstone and fine-grained sandstone with pebbly stringers (James, 1982). The Falor Formation is correlated to the upper section of the Wildcat Group (James, 1982). Other Quaternary – Tertiary Overlap deposits include marine terraces, fluvial terraces, dune deposits, and Holocene alluvium and beach deposits.

Pleistocene to Holocene marine terrace deposits cover the bedrock surfaces on wave-cut benches within about two miles of the coastline, and up to 260 feet above sea level. These deposits are composed of slightly consolidated silts, sands and gravels, which have been uplifted and offset by subsequent fault movements (Kelley 1984; Kelsey and Carver 1988). These deposits cover the bedrock at various locations adjacent to the present stream and river channels, but at higher levels than the active channel deposits. As many as six separate terrace levels have been identified at some locations, with progressively older terrace deposits at correspondingly higher levels. These deposits are composed of unconsolidated, poorly sorted sands, gravels, and boulder conglomerates. Fluvial terrace deposits are most extensive adjacent to Lindsay Creek in the Fieldbrook area and adjacent to the Mad River at Blue Lake and Butler Valley (Kelley, 1984; James, 1982; Kilbourne, 1983-85).

Ancient dune sand deposits, of Pleistocene to Holocene age, overlie the bedrock up to 4 miles from the present coastline, and up to 620 feet ASL. These deposits are composed of unconsolidated fine to course grained sand (Kelley, 1984). The ancient dune sands may be part of the Hookton Formation located south of the area covered in this study. These materials are extremely erodible where they are exposed, and they are subject to slumping where slopes are undercut.

Holocene alluvium, flood plain deposits, and beach deposits are present in active stream and river channels, in valley bottoms, and on the coastal plain. They are composed of poorly sorted, unconsolidated mixtures of boulders, gravel, sand, silt, and clay (James, 1982; Kelley, 1984; Kilbourne, 1983-85; Ristau, 1979). These deposits are reworked by meandering and shifting stream channels, especially during the infrequent large flood events. The sediment progressively migrates downstream, with new material being added at multiple points along the channels by erosion and landslide movement. Some of that new material is transported out to sea or removed by gravel mining.

Pleistocene to Holocene marine terrace deposits cover the bedrock surfaces on wave-cut benches within about 2 miles of the coastline, and up to 260 feet ASL. These deposits are composed of slightly consolidated silts, sands, and gravels, which have been uplifted and offset by subsequent fault movements (Kelley, 1984; Kelsey and Carver, 1988).

Published landslide maps indicate that both shallow and deep-seated landslides exist throughout this HPA. Deep-seated rotational/translantional landslides and earthflows are common in the Franciscan Mélange. Younger bedrock in the Primary Assessment Area is generally described as poorly consolidated, uncemented, interbedded sands, silts, clays, and gravels. These materials are extremely erodible, and they are very susceptible to slumping and rotational slide movement.

3.2.4.9 North Fork Mad River Hydrologic Unit

The North Fork Mad River Hydrologic Unit is approximately 31,000 acres. Bedrock within the North Fork Mad River Hydrologic Unit is composed mostly of Central Belt Franciscan Complex with Quaternary – Tertiary Overlap deposits in the southwest section of the unit juxtaposed by the Mad River thrust fault system.

From east to west, the Franciscan bedrock within the Primary Assessment Area is Redwood Creek Schist along the east margin, Sandstone and Mélange of Snow Camp Mountain and Undifferentiated Franciscan Complex rocks, also identified as Broken Formation rock on the west side of the Undifferentiated Franciscan (McLaughlin et al., 2000) and Quaternary – Tertiary Overlap deposits (Figure 3.2-1). The northwest-trending, northeast-dipping Bald Mountain Fault separates rocks of the Redwood Creek Schist and the Snow Camp Mountain unit in the east portion of the watershed.

The topography of the unit is relatively steep and mountainous, similar to the rest of the Mad River watershed. Similar to the other Mad River hydrographic regions, both shallow and deep-seated landslides exist throughout this HPA. Deep-seated rotational / translational landslides and earthflows are common in the Franciscan mélange. Younger bedrock in the Primary Assessment Area is generally described as poorly consolidated, uncemented, interbedded sands, silts, clays, and gravels. These materials are extremely erodible, and they are very susceptible to slumping and rotational slide movement.

3.2.4.10 Humboldt Bay Hydrographic Region

The Humboldt Bay Hydrographic Region is approximately 139,000 acres. The Humboldt Bay Hydrographic Region includes Quaternary – Tertiary overlap deposits and Quaternary age alluvium, with Yager Terrane near the southern boundary of the region and Central Belt Franciscan Complex bedrock under the eastern quarter of the region.

The bedrock in this region includes both Quaternary – Tertiary overlap deposits and the Central Belt Franciscan mélange. The overlap deposits within the Primary Assessment Area include the Wildcat Group, which is composed of moderately consolidated, poorly cemented, weak siltstone, claystone, and fine sandstone, as well as the Falor Formation. These strata were deposited on an erosional surface of Franciscan and Yager Formation rocks, and they have been subsequently eroded, faulted, folded, and partly covered with younger sedimentary rocks. The Central Belt Franciscan Mélange is described as a weak, pervasively sheared claystone matrix, which encloses various-sized blocks of hard sandstone, greenstone, metavolcanic rock, serpentinite, chert, and schist. Some of the different lithologic blocks in the mélange are large enough to be mapped separately at a large enough scale.

The Fickle Hill Fault (part of the Mad River Fault zone), the Freshwater Fault, and the Little Salmon Fault are the three main faults within the Humboldt Bay region. They have north-northwest to northwest alignments and northeast dips. The Little Salmon Fault and the Table Bluff Anticline define the topographic high at the southwest boundary of the hydrographic region, and the Freshwater Fault separates the Central Belt Franciscan Complex from the younger rock formations in the central portion of the region.

Topography within the Quaternary – Tertiary overlap deposits is well dissected and of relatively low relief. The Wildcat Group and younger rocks in most of the Humboldt Bay Hydrographic Region are highly erodible, and fragments of the rock readily breakdown in the streambeds to sand, silt, and clay.

Published landslide maps indicate that both shallow- and deep-seated landslides exist within this HPA.

3.2.4.11 Eel River Hydrographic Region

The Eel River Hydrographic Region is approximately 205,000 acres and contains Quaternary-Tertiary overlap deposits and Quaternary age alluvium with Coastal Belt Franciscan Complex bedrock near the southern boundary of the region and Yager Terrane and

Central Belt Franciscan bedrock under the eastern third of the region. Coastal Belt Franciscan bedrock underlies a very small portion of the Primary Assessment Area at the south end of the hydrographic region (Figure 3.2-1).

The geologic structure of the area follows the northwest trend of regional geologic structure. The Little Salmon Fault, which is known to be presently active, passes through the Eel River Hydrographic Region. The Freshwater Fault juxtaposes the Yager Terrane and Central Belt Franciscan bedrock and the Ferndale Fault defines the trace of the Van Duzen River at its confluence with the Eel River.

Topography within the Quaternary – Tertiary overlap deposits is highly variable and includes some steep slope segments. Published landslide maps indicate that both shallow and deep-seated landslides exist within this HPA.

3.2.4.12 Rain-on-Snow Areas Located Outside of the HPAs

Simpson ownership in the rain-on-snow areas outside the HPAs are shown on Figure 3.2-1. The following information is based on geologic maps published by CDMG (Strand, 1962; Redding, Sheet, and Wagner and Sucedo, 1987; Weed Sheet).

The ownership located to the northeast of the Primary Assessment Area along the Oregon-California border, is in a watershed that drains into the Middle Fork of the Smith River. This tract is predominantly underlain by Galice Formation bedrock of the Western Jurassic Belt of the Klamath Mountains Province. Galice Formation bedrock is composed of slate, partially serpentinized peridotite, meta-graywacke, and stretched pebble conglomerate. Along the western margin of this tract is metavolcanic bedrock of the Western Jurassic Belt. Elevations in this area range from approximately 3,000 feet to 4,000 feet. Topography is relatively steep and well dissected.

The ownership located east of Minor Creek and Redwood Creek near U.S. Highway 299 is predominantly underlain by the South Fork Mountain Schist geologic unit with areas of undifferentiated Central Belt Franciscan Complex bedrock and possibly limited occurrences of partially serpentinized ultra mafic bedrock. Elevations in the area range from 2,500 feet to 4,500 feet. Topography is variably steep and the drainage pattern appears to be structurally controlled (trellised).

The ownership located to the east of Pilot Creek and adjacent to the Mad River Hydrographic Region is in a watershed which drains to the Trinity River. This tract is predominantly underlain by the South Fork Mountain Schist geologic unit with areas of Upper Jurassic Age marine bedrock, Mesozoic granitic bedrock, and Cenozoic non-marine clastic bedrock. This area is included in the Franciscan Complex bedrock of the Coast Range Province. Elevations in the area range from approximately 2,000 feet to 5,000 feet. Topography is variably steep and the drainage pattern appears to be trellised.

Although no landslides were mapped on the geologic maps used to compile these descriptions, based on the mountainous terrane in these areas, it is reasonable to assume that there is the potential for both shallow and deep-seated landslides.

3.2.5 Mineral Resources

The description presented below is intended to provide a general overview of the known occurrences of commercial mineral resources and operating rock products facilities in the general vicinity of the Primary Assessment Area. Even though mineral resources and rock products of economic importance occur within the vicinity of Primary Assessment Area, extraction and processing of these resources would not be affected by the Proposed Action or the other alternatives. Simpson’s rock pits are generally fewer that 2 acres in size; are located more than 100 and 75 feet from Class I and II streams, respectively; and are exempt from Surface Mining and Reclamation Act (SMRA) regulations. Therefore, a comprehensive assessment of the mineral resources and their extraction, processing, and use in the Primary Assessment Area was not undertaken for this EIS, and the information provided below is based on a survey of available literature only.

Currently, no commercial base metal (e.g., lead, zinc, copper) or precious metal (e.g., gold, silver) mineral production occurs in Del Norte or Humboldt counties, or on Simpson lands; however, commercial deposits of nickel and cobalt are in the vicinity of the Primary Assessment Area in Del Norte County. In 1977, a proposal for mining nickel and cobalt was submitted by Cal-Nickel Corporation. The company proposed mining of laterite deposits on Gasquet Mountain between the North Fork of the Smith River and Hardscrabble Creek (Institute for River Ecosystems at Humboldt State University, 1997). Because of economic considerations, the project is on hold, as are permitting and environmental issues (pers. com., Jay Sarina, Planning Division, County of Del Norte).

Historically, gold mining played an important role in the early economy of Del Norte and Humboldt counties (Ogle, 1953). Gold mining included numerous prospects of both placer and lode deposits. In addition to gold, other base and precious metals mined or prospected in the region include copper, chormite, manganese, zinc, and silver (CDMG Minefile Database, 2001). Manganese and copper were historically produced from the Franciscan Coastal Belt rocks and possibly from the Yager Formation (USFWS and CDF, 1998).

Historical mining activity in the Primary Assessment Area also includes sand, gravel, and rock mining, with sand and gravel constituting the main non-fuel mineral resource (Ogle, 1953; Logan, 1947; Strand, 1962; Youngs and Kohler-Antablin, 1966; CDMG Minefile Database, 2001). These sources also identify historical stone production near the Primary Assessment Area, including rock and some small limestone bodies. Sand and gravel deposits occur along the current river and stream channels of the Primary Assessment Area. Additional sand and gravel is found in the Quaternary-Tertiary Wildcat Formation and the Hookton Formation. Building stone is and has historically been quarried from the Yager Formation and the Franciscan Coastal and Central Belt rocks. Limestone, presumably from the mélange of the Franciscan Central Belt rocks, was historically mined for Portland grade cement (Ogle, 1953; Strand, 1962).

Commercial deposits of sand, gravel, and stone exist in the vicinity of the Primary Assessment Area (CDMG Minefile Database, 2001). The geological formations that host these deposits are widespread in both Humboldt and Del Norte counties. At present, the CDMG Minefile Database lists 51 mining operations (rock quarries, sand and gravel operations, and borrow pits) in Humboldt County and 16 mining operations in Del Norte County (CDMG SMRA Eligible List as of 07/30/2001).

Simpson operates numerous rock quarries (borrow pits) within the Primary Assessment Area. These mining operations are used to supply surfacing or fill material for purposes of road construction and maintenance associated with timber harvesting and forest management. The pits are generally smaller than 2 acres in size and are located more than 100 and 75 feet from Class I and Class II watercourses, respectively. Because of their location and purpose (i.e., road construction and maintenance associated with timber harvesting and forest management), they are exempt from regulation under SMRA as administered by the California Division of Mines and Geology. Two valid State of California permits for rock mining within the Primary Assessment Area are presently held by Mercer-Fraser.

Hydrocarbon resources (natural gas) exist near the southern border of the Primary Assessment Area. Currently, gas is produced in commercial quantities from an area known as the Tompkins Hill gas field. The Tompkins Hill field is located in the Eel River sedimentary basin; records indicate this basin has produced gas since 1937 (McLean, 1993). The gas comes from the sandstones of the Rio Dell Formation of the Wildcat Group. Production records for 1998 list gas production at Tompkins Hill at roughly 1.3 million cubic feet (DOGGR, 1998). Other gas fields in the area include the Table Bluff and Grizzly Bluff fields. However, both of these fields are listed by CDMG as abandoned (DOGGR, 2001).

3.3 Hydrology and Water Quality

3.3.1 Introduction

This section provides descriptions of the watersheds within the HPAs, estuarine conditions for coastal areas, and baseline hydrology and water quality summaries. Watersheds may be wholly included in or split among several HPAs.

Logging, mining, road building, and grazing over the course of the last 100 years, combined with the local existence of steep slopes, unstable geologic formations, and seasonally intense precipitation, have produced runoff and erosion concerns for portions of the Primary Assessment Area. The north coast of California receives some of the heaviest precipitation in the state in the form of rain, snow, or both, depending on elevation.

Enhanced runoff, erosion, sedimentation, suspended sediments, and temperature are the chief water quality concerns of these coastal drainages. Some stream reaches and watersheds have been listed as impaired waterbodies by the RWQCB, and as such are subject to development of TMDLs. TMDLs will provide guidance for regulating suspended sediment concentrations or loads within certain project watersheds.

3.3.2 Watershed Characteristics

The regional geology, HPAs, and rivers in the vicinity of the Primary Assessment Area are shown on Figure 3.2-1 (Section 3.2, *Geology, Geomorphology, and Mineral Resources*). Key characteristics of these watersheds and HPAs are summarized in Table 3.3-1. Information specific to Simpson fee-owned lands within each HPA is also presented that typifies much of the remainder of the Primary Assessment Area for which detailed information is unavailable.

Currently, Simpson's fee-owned lands within the Primary Assessment Area contain more than 1,500 miles of Class I and II streams, 73 percent of which are Class II watercourses. In addition, Simpson's fee-owned lands contain about 3,800 miles of road within the HPAs, 85 percent of which are categorized as "seasonal."

TABLE 3.3-1
HPA Characteristics

HPA	HPA Acreage	Simpson Acreage Within HPA	Simpson Percentage	Simpson Road Miles	Class I Stream Miles	Class II Stream Miles	Class I and II Stream Miles
Smith River Hydrographic Region	181,999	41,163	22.6	387	55.4	149.3	204.7
Coastal Klamath Hydrographic Region	108,150	87,116	80.6	830	95.0	229.1	324.1
Blue Creek Hydrologic Unit	80,303	15,355	19.1	142	14.4	52.4	66.8
Interior Klamath Hydrographic Region	128,006	66,127	51.7	542	38.2	165.1	203.3
Redwood Creek Hydrologic Unit	188,335	33,223	17.6	274	21.4	93.9	115.3
Coastal Lagoons Hydrographic Region	53,592	39,999	74.6	329	73.4	54.8	128.2
Little River Hydrologic Unit	29,703	26,041	87.7	294	38.6	56.0	94.6
Mad River Hydrographic Region	119,686	49,497	41.4	435	38.6	169.7	208.3
North Fork Mad River Hydrologic Unit	31,416	28,219	89.8	307	28.3	114.8	143.1
Humboldt Bay Hydrographic Region	138,719	17,465	12.6	201	10.8	15.8	26.6
Eel River Hydrographic Region	205,160	7,940	3.9	92	3.3	22.4	25.7
Total	**1,265,069**	**412,146**	**32.6**	**3,831**	**417.5**	**1,123.2**	**1,540.7**

The HPA areas are part of nine contiguous coastal drainage basins that encompass approximately 13.7 million acres in northwestern California and southern Oregon. The size of the Primary Assessment Area and Simpson's fee ownership relative to the coastal basins directly correlates to the potential influence of Simpson's timber operations on these basins. Some of the HPAs represent a small proportion of the total area in the coastal basins of which they are a part, while others encompass the entire basin. Simpson's fee ownership in the largest coastal basins (Klamath, Smith, and Eel Rivers) is concentrated in HPAs near the coast and is very small relative to total basin size, limiting the influence of Simpson's operations on these watersheds. Upstream factors including dams, water diversions, development, and other commercial land uses (e.g., agriculture and non-Simpson timber management activities) further reduce the relative impact of Simpson's operations on these drainages. Some of the smaller coastal basins, in contrast, are largely owned by Simpson, and Simpson's management activities may be the main human-caused influence within these drainages.

3.3.3 Climate

The climate of the HPAs is highly variable, dependent on elevation and slope, but is generally representative of the cool, rainy climate of the coastal area of northern California. The general climatic conditions influence the hydrology of the HPAs and associated watersheds and are summarized by HPA below.

Additional Simpson areas to be evaluated as part of Alternative C are described as rain-on-snow areas and are generally higher in elevation than most of the HPA areas described below. The rain-on-snow Simpson lands range in elevation from 2,400 feet to 5,000 feet. Precipitation in these areas occurs mostly as snow at elevations above 3,500 feet and ranges from 60 inches to 70 inches per year.

3.3.3.1 Smith River Hydrographic Region

This hydrographic region is located in one of the wettest areas of California. Average annual rainfall varies from about 60 inches at Point St. George to more than 125 inches at higher inland areas. The precipitation is orographic in nature, increases with elevation, and is usually greater on the windward (southwest) slopes. About 75 percent of the precipitation occurs between November 1 and March 31 (90 percent between October 1 and April 30). Average annual snowfall in the unit ranges from 28 inches at elevations of 1,700 feet ASL (Elk Valley) to 126 inches at 2,420 feet ASL (Monumental).

The climate in this area is primarily influenced by marine air masses and cold air drainage from higher elevations. Occasionally, the climate is influenced by drier air masses associated with east winds.

3.3.3.2 Coastal Klamath Hydrographic Region

The large size of the Klamath basin and its geographic differences results in a wide range of climatic conditions. For the entire basin, the weather can be generalized as having dry summers with hot daytime temperatures and wet winters with low to moderate temperatures. Peak air temperatures occur during July with a monthly average maximum of 18.3°C for the coast and 35°C inland. Precipitation is seasonal, with approximately 90 percent falling between October and March. Annual amounts vary from 20 inches to more than 80 inches, depending on location. High intensity rainfall occurs December through February and may cause flooding at times. Snow occurs at higher elevations and some areas receive up to 80 inches annually.

3.3.3.3 Blue Creek Hydrologic Unit

Precipitation in the Blue Creek headwaters averages 100 inches annually, 75 percent of which falls between November and March (Helley and LaMarche, 1973, as cited in Voight and Gale, 1998). Air temperatures in the region are mainly affected by the coastal marine climate, with daily high temperatures ranging from 4.4 - 21.1°C annually. During the summer the climate is moderated by coastal fog, which reduces solar radiation and contributes moisture by fog drip.

3.3.3.4 Interior Klamath Hydrographic Region

The large size of the Klamath basin and its geographic differences result in a wide range of climatic conditions. In the interior (e.g., South Fork Trinity sub-basin), the climate is generalized by hot, dry summers and cool, wet winters. The average annual precipitation for the South Fork Trinity sub-basin is 30 to 60 inches, depending on altitude and distance from the Pacific Ocean. Most precipitation falls between November and March, with negligible amounts in localized areas between June and September. Snow is a major component of the annual precipitation in higher elevations.

3.3.3.5 Redwood Creek Hydrologic Unit

Precipitation in the Redwood Creek basin is highly seasonal, with 90 percent occurring between October and April. The annual average for the basin is almost 80 inches, with more than 90 inches occurring in localized areas. December is usually the wettest month with about 17 percent of the annual total.

3.3.3.6 Coastal Lagoons Hydrographic Region

A coastal weather pattern is typical for the lagoons. Summers are mild in temperature with a marine fog layer commonly occurring; winters are cooler. The average annual rainfall is 40 to 60 inches, with heavier amounts falling in the more inland areas. Most of the precipitation falls between October and April.

3.3.3.7 Little River Hydrologic Unit

The Little River drainage has a weather pattern similar to most northern California coastal watersheds, typically with wet winters and dry summers. At least 80 percent of the precipitation occurs between November and April. The coastal area receives about 50 inches annually, whereas interior parts of the watershed receive over 80 inches annually. Most of the precipitation falls as rain, although snowfall occurs at the higher elevations. Coastal marine fog is common during the summer months.

3.3.3.8 Mad River Hydrographic Region

In the Mad River basin, 75 percent of the annual precipitation occurs between November and March. Annual precipitation levels range from around 40 inches at the coast to greater than 70 inches in the central basin. The basin average is approximately 63 inches. In the upper basin, snow averages 23 inches annually and usually occurs above 3,000 feet, but snow levels may occasionally drop to as low as 1,000 feet ASL.

3.3.3.9 North Fork Mad River Hydrologic Unit

The average daily air temperature in the North Fork Mad River Hydrologic Unit ranges from a high of 16.7°C during August to a low of 4.4°C in January. The average annual precipitation in the hydrologic unit ranges from 60 to 80 inches, with rainfall increasing inland. Most precipitation occurs between October and May. Snow usually occurs above 3,000 feet ASL, but snow levels may occasionally drop to as low as 1,000 ASL.

3.3.3.10 Humboldt Bay Hydrographic Region

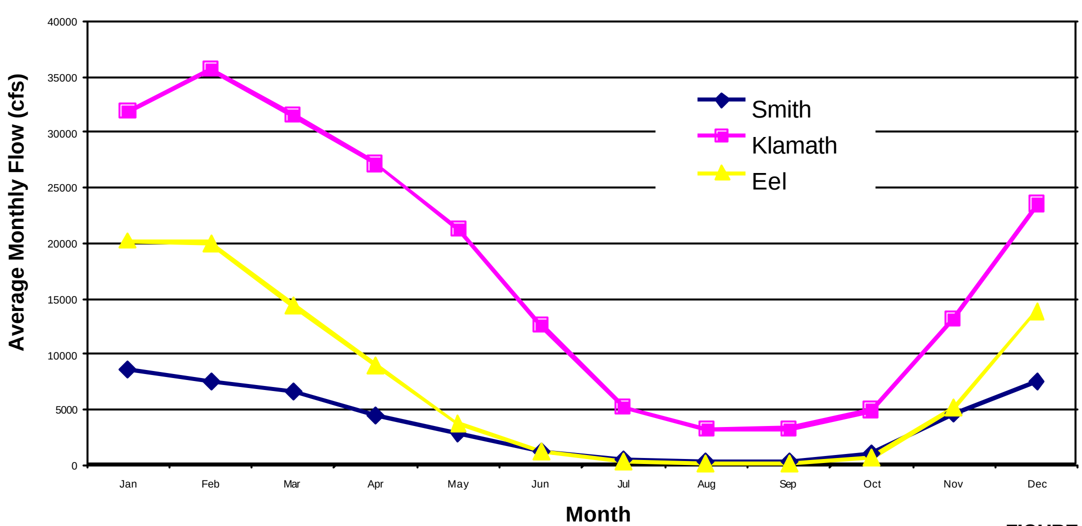
The watersheds that drain into Humboldt Bay are influenced by the coastal weather patterns of northern California. Typically, the majority of precipitation falls as rain between November and April with snowfall occurring sporadically at higher elevations. Coastal areas around Eureka receive about 35 to 40 inches of rain annually, whereas inland areas of the basin may receive 60 inches or more per year. During the summer the climate is moderated by coastal fog, which reduces solar radiation and contributes moisture by fog drip.

3.3.3.11 Eel River Hydrographic Region

Like the majority of northern California, climate in the Eel River basin is characterized by wet winters and dry summers. Nearly 80 percent of the annual precipitation falls between November and April. The average annual precipitation varies from less than 40 inches in the Eel River Plain and Round Valley to more than 110 inches in the Bull Creek headwaters. The average annual precipitation for the entire Eel River basin is about 60 inches. Fog drip during the summer months is a source of precipitation not included in annual totals. The dense, often persistent, band of marine fog usually extends 20 to 30 miles inland. Measurements in the Bear River Ridge revealed fog drip accumulations of 12 inches in open areas and 8.5 inches under forest canopy.

3.3.4 Baseline Hydrologic Data

Peak flows in the northern coastal watersheds usually occur during winter storms in January. The Eel, Smith, and Klamath Rivers had mean peak daily flows of 395,000 cubic feet per second (cfs), 75,500 cfs, and 397,000 cfs, respectively, for January flows during 1974 and 1975 storms. The typical annual pattern of flows for these rivers is shown on Figure 3.3-1. Note that the streams are markedly seasonal with extended low flow periods during the summer and fall. These rivers are the major project drainages and are shown as examples of typical seasonal flow patterns.



Period of Record: Smith 10/01/1931 to 9/30/1999
Klamath 10/01/1910 to 9/30/1926, 10/01/1950 to 10/29/1995, 10/01/1997 to 9/30/1999
Eel 10/01/1910 to 9/30/1914, 10/01/1916 to 9/30/1999

FIGURE 3.3-1
Average Monthly Flows of Project Rivers

3.3.5 Water Quality

Most surface waters in the Primary Assessment Area have not been sampled for water quality, but key constituents of concern (temperature, suspended sediment, turbidity) have been analyzed from a number of locations. Values generally meet or exceed minimum RWQCB Basin Standards, although some of the streams are listed as impaired under Section 303(d) of the CWA. The list of waterbody impairments is shown in Table 3.3-2. The causes for impairment in these streams vary, but include such factors as:

- Nonpoint-source erosion / siltation
- Rangeland
- Silviculture
- Loss of riparian vegetation
- Logging roads
- Streambank destabilization
- Erosion / siltation

General characteristics of Primary Assessment Area streams can be derived from U.S. Geological Survey (USGS) stream monitoring records for the major rivers. Table 3.3-3 shows mean daily ranges of temperature, turbidity, and conductivity for the Smith, Klamath, and Eel Rivers near their mouths.

TABLE 3.3-2
Waterbody Impairment and Beneficial Uses for Impaired Water Bodies in Primary Assessment Area Watersheds

Watershed	Listed Impairment	Existing Beneficial Uses [a]
Klamath River	Temperature, nutrients, dissolved oxygen	MUN, AGR, GWR, FRSH, NAV, REC1, REC2, COMM, WARM, COLD, MIGR, SPWN, EST, AQUA
Redwood Creek [b]	Sediment	MUN, AGR, IND, REC1, REC2, COMM, COLD, WILD, RARE, MIGR, SPWN, SHELL, EST
Mad River	Sediment, turbidity	MUN, AGR, IND, PROC, POW, REC1, REC2, COMM, WARM, COLD, WILD, RARE, MIGR, SPWN, EST, AQUA
Eel River	Sediment, temperature	MUN, AGR, IND, GWR, NAV, POW, REC1, REC2, COMM, WARM, COLD, WILD, RARE, MIGR, SPWN, EST, AQUA
Van Duzen River	Sediment	MUN, AGR, IND, REC1, REC2, COMM, COLD, WILD, RARE, MIGR, SPWN, AQUA
Freshwater Creek	Sediment	MUN, COMM, EST
Elk River	Sediment	MUN, COMM, EST

[a] Beneficial use codes are MUN municipal and domestic, AGR agricultural, IND industrial, PROC industrial process, GWR groundwater recharge, FRSH freshwater replenishment, NAV navigational, POW hydropower generation, REC1 body contact recreation, REC2 non-contact recreation, COMM commercial and sport fishing, WARM warm freshwater habitat, COLD cold freshwater habitat, WILD wildlife habitat, RARE threatened or endangered species, MIGR migration of aquatic organisms, SPWN fish spawning, SHELL shellfish, EST estuarine habitat, AQUA aquaculture.

[b] Planning and restoration for Redwood Creek will be with the National Park Restoration Plan.

TABLE 3.3-3
Range of Mean Daily Water Quality Values for Three Primary Assessment Area Rivers

Parameter	Klamath River Near Klamath	Smith River at Crescent City	Eel River at Scotia
Daily mean temperature range (°C)	4 – 27.5	3 – 21.5	5 – 23.5
Daily mean turbidity range (NTU)	0 - 95	0.2 - 12	0 - 380
Daily mean conductivity range (umhos/cm)	95 - 250	63 - 159	90 - 351
Period of record	1973 - 1995	1973 - 1993	1973 - 1995

Source: USGS stream monitoring records.

The records of high turbidity and low conductivity were all found in winter months during days of high runoff. High temperatures in late summer were all during low flow periods.

In addition to the long-term records from the lower elevation gaging stations, water temperature monitoring has been conducted since 1994 in the various HPAs. As of the end of the year 2000, more than 400 temperature profiles have been recorded at 111 Class I (fishbearing) stream sites and 210 profiles at 70 sites in Class II streams with the following objectives:

- Document the highest 7DMAVG (the average of all temperatures recorded over a 7-day period) and daily fluctuations for each site.
- Determine seasonal maximum water temperatures.
- Identify stream reaches with temperatures that may exceed the thresholds of any of the covered species.

In addition to documentation of average stream temperatures and species-specific temperature thresholds, relationships were developed between temperature and drainage area as a means of accounting for the natural variation in water temperatures. These regression relationships yielded confidence limits of temperature based on drainage basin area. Individual values greater than those limits were viewed as possible locations of temperature exceedances for aquatic species of concern. Summary descriptions of temperatures relative to exceedance thresholds for specified aquatic species of concern are provided below for purposes of defining temperature variability between lower and upper watershed reaches within each HPA. A complete description of the temperature monitoring program, that includes site locations, summarized data, and appropriate temperature thresholds for salmonids can be found in Appendix C-5 of the proposed AHCP/CCAA. Monitoring data on suspended sediments and turbidity are not available for watershed reaches in each HPA.

3.3.5.1 Smith River Hydrographic Region

Summer water temperatures within the Smith River Hydrographic Region have been below the recommended NMFS Maximum Weekly Average Temperature (MWAT) threshold value for juvenile coho of 17.4°C (NMFS, 1997) at every monitored location throughout 6 years of temperature monitoring. The average 7DMAVG for all 61 Class I temperature profiles recorded since 1994 was 14.4°C. The highest recorded 7DMAVG value was 17.3°C in lower Goose Creek in 1997. Water temperature does not appear to be a limiting factor for salmonids in the Smith River Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 94 of the 113 recorded profiles (83 percent). The highest 7DMAVG recorded was 17.3°C and the average 7DMAVG for all summer temperature profiles was 13.6°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Smith River Hydrographic Region at most sites and most years of monitoring.

3.3.5.2 Coastal Klamath Hydrographic Region

Summer water temperatures within the Coastal Klamath Hydrographic Region have been above the recommended NMFS threshold value for juvenile coho of 17.4°C in only two of the 67 recorded Class I temperature profiles. 7DMAVG values of 17.4°C and 17.6°C were recorded in lower Turwar Creek in 1994 and 1997, respectively. The average 7DMAVG for all 67 Class I temperature profiles recorded since 1994 was 15.0°C. Water temperature does not appear to be a limiting factor for salmonids in the Coastal Klamath Hydrographic Region.

Maximum temperatures at the monitoring sites (Class I and II streams) have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 53 of the 75 recorded profiles (71 percent). The highest 7DMAVG recorded in headwater streams was 17.6°C and the average 7DMAVG for all headwater summer temperature profiles was 14.8°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Coastal Klamath Hydrographic Region at most sites and most years of monitoring.

3.3.5.3 Blue Creek Hydrologic Unit

Summer water temperatures within the Blue Creek Hydrologic Unit have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C in only one of the 23 recorded Class I temperature profiles. A 7DMAVG values of 18°C was recorded in Blue Creek in 1997. The average 7DMAVG for all 23 Class I temperature profiles recorded since 1994 was 15.1°C. Water temperature does not appear to be a limiting factor for salmonids in the Blue Creek Hydrologic Unit.

Maximum temperatures at the headwaters monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 19 of the 28 recorded profiles (68 percent). The highest 7DMAVG recorded in headwater streams was 18°C and the average 7DMAVG for all summer temperature profiles was 15.0°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Blue Creek Hydrologic Unit at most sites and most years of monitoring.

3.3.5.4 Interior Klamath Hydrographic Region

Summer water temperatures within the Interior Klamath Hydrographic Region have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C in only three of the 23 recorded Class I temperature profiles. The average 7DMAVG for all Class I temperature profiles recorded since 1994 was 14.8°C. Water temperature does not appear to be a limiting factor for salmonids in Interior Klamath Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 20 of the 30 recorded profiles (67 percent). The highest 7DMAVG recorded in headwater streams was 20.1°C, and the average 7DMAVG for all headwater summer temperature profiles was 14.6°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Interior Klamath Hydrographic Region at most sites and most years of monitoring.

3.3.5.5 Redwood Creek Hydrologic Unit

Summer water temperatures within the Redwood Creek Hydrologic Unit have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C in 4 of the 15 recorded Class I temperature profiles. A 7DMAVG value of 22°C was recorded in Redwood Creek at Panther in 2000. The other occurrences of 7DMAVG temperatures above 17.4°C have also been in the mainstem of Redwood Creek and lower Coyote Creek. The average 7DMAVG for all Class I temperature profiles recorded since 1994 was 15.7°C. Summer water temperature may be a limiting factor for salmonids in Redwood Creek itself, while temperatures in tributaries to Redwood Creek appear to remain relatively cool through the summer.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 29 of the 37 recorded profiles (78 percent). The highest 7DMAVG recorded in all streams was 22°C, and the average 7DMAVG for all headwater summer temperature profiles was 14.7°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Redwood Creek Hydrologic Unit at most sites and most years of monitoring.

3.3.5.6 Coastal Lagoons Hydrographic Region

Summer water temperatures within the Coastal Lagoons Hydrographic Region have been below the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C at all Class I sites throughout 6 years of temperature monitoring. The highest recorded 7DMAVG value was 16.1°C in lower Maple Creek in 2000. The average 7DMAVG for all 43 Class I temperature profiles recorded since 1994 was 14.4°C. Water temperature does not appear to be a limiting factor for salmonids in the Coastal Lagoons Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 61 of the 65 recorded profiles. The highest 7DMAVG recorded in all streams was 16.5°C, and the average 7DMAVG for all summer temperature profiles was 14.0°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Coastal Lagoons Hydrographic Region.

3.3.5.6 Coastal Lagoons Hydrographic Region

Summer water temperatures within the Little River Hydrologic Unit have been at the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C twice throughout 6 years of temperature monitoring. A 7DMAVG value of 17.4°C was recorded in the lower Little River in 1996 and 2000. The average 7DMAVG for all 44 Class I temperature profiles recorded since 1994 was 14.9°C. Water temperature does not appear to be a limiting factor for salmonids in the Little River Hydrologic Unit.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 58 of the 72 recorded profiles (81 percent). The highest 7DMAVG recorded in headwater streams was 17.4°C, and the average 7DMAVG for all headwater summer temperature profiles was 14.0°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Little River Hydrologic Unit at most sites and most years of monitoring.

3.3.5.8 Mad River Hydrographic Region

Summer water temperatures within the Mad River Hydrographic Region have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C eight times at three sites: middle Canon Creek in 2000, and lower Canon Creek between 1996 and 2000, and Boulder Creek in 1997 and 1998. The highest recorded 7DMAVG was 18.8°C in lower Canon Creek in 1997. The average 7DMAVG for all 37 Class I temperature profiles recorded since 1994 was 16.1°C. Summer water temperature may be a limiting factor for salmonids in portions of the Mad River Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 68 of the 90 recorded profiles (76 percent). The highest 7DMAVG recorded in all streams was 18.8°C, and the average 7DMAVG for all headwater summer temperature profiles was 12.9°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Mad River Hydrographic Region at most sites and most years of monitoring.

3.3.5.9 North Fork Mad River Hydrologic Unit

Summer water temperatures within the North Fork Mad River Hydrologic Unit have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C in one reach, the lower North Fork Mad River, in every year it was monitored (1994-2000), with 7DMAVG values ranging from 17.7°C in 1994 to 19.7°C in 1996. The average 7DMAVG for all 39 Class I temperature profiles recorded since 1994 was 15.3°C. Temperatures at all other sites in this HPA have been below the recommended NMFS threshold for juvenile coho except for site 1a on the North Fork Mad River in 1998. Summer water temperatures may be a limiting factor for salmonids in the lower mainstem North Fork Mad River, but do not appear to be limiting in the upper North Fork Mad River or tributaries to it.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 39 of the 52 recorded profiles (75 percent). The highest 7DMAVG recorded in streams was 19.7°C, and the average 7DMAVG for all summer temperature profiles was 14.8°C. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the North Fork Mad River Hydrologic Unit at most sites and most years of monitoring.

3.3.5.10 Humboldt Bay Hydrographic Region

Summer water temperatures within the Humboldt Bay Hydrographic Region have been above the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C twice at lower Salmon Creek throughout 6 years of monitoring. The recorded 7DMAVG values at the site were 18.1°C in 1997 and 17.4°C in 1998. The average 7DMAVG for all 35 Class I temperature profiles recorded since 1994 was 14.7°C. Summer water temperatures do not appear to be a limiting factor for salmonids in the Humboldt Bay Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in 28 of the 35 recorded profiles (80 percent). The highest 7DMAVG recorded in Class I streams was 18.1°C, and the average 7DMAVG for all headwater summer temperature profiles was 14.7°C. No Class II sites have been monitored to date. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Humboldt Bay Hydrographic Region at most sites and most years of monitoring.

3.3.5.11 Eel River Hydrographic Region

Summer water temperatures within the Eel River Hydrographic Region have been below the recommended NMFS threshold MWAT value for juvenile coho of 17.4°C at every site throughout 6 years of monitoring. The highest recorded 7DMAVG values was 16.6°C in Stevens Creek in 2000. The average 7DMAVG for all 12 Class I temperature profiles recorded since 1994 was 14.7°C. Summer water temperatures do not appear to be a limiting factor for salmonids in the Eel River Hydrographic Region.

Maximum temperatures at the monitoring sites have been below the upper limiting temperatures for tailed frogs (18.5°C) and the thermal stress threshold for southern torrent salamanders (17.2°C) in all but two of the 12 recorded profiles. The highest 7DMAVG recorded in Class I streams was 16.6°C, and the average 7DMAVG for all summer temperature profiles was 14.7°C. No Class II sites have been monitored to date. Water temperature does not appear to be a limiting factor for tailed frogs or southern torrent salamanders in the Eel River Hydrographic Region for most sites and years of monitoring.

3.4 Aquatic Resources

3.4.1 Introduction

This section describes fisheries and other aquatic resources occurring within the Primary Assessment Area and the additional 26,116 rain-on-snow acres under Alternative C that could potentially be affected by approval of the proposed permits (Proposed Action), other action alternatives, or the No Action Alternative. Discussions focus on eight fish, four amphibian, and one reptile species occurring or potentially occurring within these areas that would be covered by one or more of the action alternatives. The distribution, status, life history and habitat requirements, and factors affecting populations of these 13 species are discussed in the following text.

This section also describes current, known aquatic habitat conditions within the Primary Assessment Area for each of the 11 HPAs previously described in Sections 3.2 and 3.3. In addition, this section summarizes general ecological implications of land management activities on aquatic habitat that have influenced, or could potentially influence, the affected environment. These descriptions are presented to inform the reader of general cause-effect relationships, and to develop the basis for assessing potential project effects on aquatic habitat and the covered species in Chapter 4, Environmental Consequences, of this document.

3.4.2 Covered Species

3.4.2.1 Background

Table 3.4-1 lists the common and scientific names of the eight fish species/ESUs, four amphibian species, and one reptile species covered under the various action alternatives, and their status under the federal and state ESAs. The designation in Table 3.4-1 of individual ESUs of steelhead and coho and chinook salmon as individual species is consistent with language in the federal ESA. An ESU must be substantially reproductively isolated from other nonspecific population units, and it must contribute substantially to ecological/genetic diversity of the biological species as a whole. Jurisdiction over coastal cutthroat trout recently transferred to the USFWS from NMFS and this species in undergoing a status review by the USFWS. Rainbow trout are the resident life history type of *Oncorhynchus mykiss* and are also under the jurisdiction of the USFWS.

TABLE 3.4-1
Federal and State Protective Status of Fish, Amphibian, and Reptile Species Covered Under the Action Alternatives

Species Common Name	Scientific Name	Coverage	Federal Status	State Status
Fish				
Southern Oregon/Northern California Coasts coho salmon ESU	*Oncorhynchus kisutch*	P,A,B,C	FT[a]	SC
Klamath Mountains Province steelhead ESU	*Oncorhynchus mykiss*	P,B,C	None[b]	None
Northern California steelhead ESU	*Oncorhynchus mykiss*	P,A,B,C	FT[b]	None
California Coastal chinook salmon ESU	*Oncorhynchus tshawytscha*	P,A,B,C	FT[c]	None
Southern Oregon and Northern California Coastal chinook salmon ESU	*Oncorhynchus tshawytscha*	P,B,C	None[c]	None
Upper Klamath-Trinity Rivers chinook salmon ESU	*Oncorhynchus tshawytscha*	P,B,C	None[c]	None
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	P,B,C	FSS[d]	CSC
Rainbow trout [e]	*Oncorhynchus mykiss*	P,B,C	None	None

TABLE 3.4-1
Federal and State Protective Status of Fish, Amphibian, and Reptile Species Covered Under the Action Alternatives

Species Common Name	Scientific Name	Coverage	Federal Status	State Status
Tidewater Goby	*Eucyclogoloius newbenyi*	C	FE	CSC
Amphibians				
Southern torrent salamander	*Rhyacotriton variegatus*	P,B,C	FSC	CSC
Tailed frog	*Ascaphus truei*	P,B,C	FSC	CSC
Foothill yellow-legged frog	*Rana boylii*	C	FSC, FSS	CSC/CFP
Northern red-legged frog	*Rana aurora aurora*	C	FSC, FSS	CSC/CFP
Reptiles				
Western pond turtle	*Clemmys marmorata marmorata*	C	FSC, FSS	CSC/CFP

Coverage
P Proposed Action: Aquatic HCP/CCA
A Alternative A: Listed Species Only
B Alternative B: Simplified Prescriptions Strategy
C Alternative C: Expanded Species and Geographic Coverage

Federal Status
FE Federal endangered species
FT Federal threatened species
FSC Federal species of concern
FSS Forest Service sensitive species

State Status
SC Candidate for state listing
CSC CDFG Species of Special Concern
CFP California Fully Protected Species

[a] The Southern Oregon/Northern California Coasts coho salmon ESU was listed as threatened on May 6, 1997, and critical habitat was designated on May 5, 1999.

[b] The Klamath Mountains Province steelhead ESU did not warrant listing as of April 4, 2001. The Northern California steelhead ESU was listed as threatened on June 7, 2000. Steelhead are the anadromous life history type of *Oncorhynchus mykiss* and are under the jurisdiction of the NMFS.

[c] The California Coastal chinook salmon ESU was listed as threatened September 16, 1999. The Southern Oregon and Northern California Coastal chinook salmon ESU did not warrant listing as of September 16, 1999. The Upper Klamath-Trinity Rivers chinook salmon ESU did not warrant listing as of March 9, 1998.

[d] The NMFS determined that the Southern Oregon/California Coasts coastal cutthroat trout ESU did not warrant listing as of April 5, 1999. This species is now under the jurisdiction of the USFWS and a review of the status of this species is being conducted.

[e] Rainbow trout are the resident life history type of *Oncorhynchus mykiss* and are under the jurisdiction of the USFWS.

Measures to minimize and mitigate the potential impacts of incidental take on the covered species are evaluated in Chapter 4, Environmental Consequences. These measures focus on assessing, conserving, and monitoring the populations and habitats of the species covered under the various alternatives. The mitigation measures, supporting analysis, and related authorizations also provide the basis for Simpson to comply with any requirements of the CFPRs relating to the ESA and the covered species.

3.4.2.2 General Information

Distribution

The 13 fish, amphibian, and reptile species discussed in this section occupy a wide range of stream reaches based on their specific habitat requirements and biological adaptations. Because of this diversity, they are dependent on a variety of stream habitats. Some larger streams may be used by all of the species, while smaller tributaries may be used by all, some, one, or none of the species. In general, chinook salmon are distributed from the coast to low-elevation streams a short distance inland. Coho salmon venture farther inland to higher elevations than chinook salmon. Steelhead, rainbow trout, and coastal cutthroat trout are distributed from the coast to higher-elevation areas farther inland than either chinook or coho salmon.

The tidewater goby is found in estuarine environments and rarely ventures far upstream into fresh water.

Many of the amphibian and reptile species are found at relatively low elevations; however, tailed frogs are generally found at higher elevations and farther inland from the coast than the fish species. Torrent salamanders are found at even higher elevations than tailed frogs.

Status of Populations

Table 3.4-1 (above) summarizes the status of the covered species for each of the action alternatives. The California Coastal chinook salmon ESU, Southern Oregon / Northern California Coasts (SONCC) coho salmon ESU, and Northern California steelhead ESU are federally listed threatened species. The NMFS determined that federal listing was not warranted for the Klamath Mountains Province steelhead ESU (April 4, 2001, 66 FR 17845), the Southern Oregon and Northern California Coastal chinook salmon ESU (September 16, 1999, 64 FR 50394), and the Upper Klamath-Trinity Rivers chinook salmon ESU (March 9, 1998, 63 FR 11482). Cutthroat trout are now under the jurisdiction of the USFWS and undergoing a status review. Rainbow trout are the resident life history type of *Oncorhynchus mykiss* and are also under the jurisdiction of the USFWS; this species is currently unlisted.

The tidewater goby is a federally listed endangered species. Southern torrent salamander, tailed frog, foothill yellow-legged frog, northern red-legged frog, and Western pond turtle have been designated as federal species of concern by the USFWS.

Life History and Habitat Requirements

General life history and habitat requirements for the 13 fish, amphibian, and reptile species discussed in this section are provided below.

Fish. The eight fish species covered under the Proposed Action are members of the family Salmonidae and exhibit varying levels of anadromy. Anadromous fish rear in freshwater for varying lengths of time, migrate to the ocean where they grow and mature, then return to freshwater to spawn and complete their life cycle. Chinook and coho salmon are exclusively anadromous; all individuals migrate from freshwater streams to the ocean and return to spawn. Steelhead are the anadromous life form of rainbow trout. Cutthroat trout primarily exist as resident populations, but limited anadromy does occur. Coho and chinook salmon die after spawning, while steelhead, rainbow trout, and coastal cutthroat trout may survive to spawn more than once. Key life history and habitat requirements of coho salmon, steelhead / rainbow trout, chinook salmon, and coastal cutthroat trout are summarized in Table 3.4-2 and discussed below under the individual species' descriptions.

TABLE 3.4-2
Key Life History and Habitat Requirements of Coho Salmon, Steelhead, Chinook Salmon, and Coastal Cutthroat Trout (from Table 3-1 of Simpson's proposed AHCP/CCAA)

Characteristic	Coho Salmon	Steelhead/Rainbow Trout	Chinook Salmon	Coastal Cutthroat Trout
Spawning Period (anadromous populations)	September to March, concentrated from January to February depending on rainfall and stream discharge	September to March depending on time of entry	September to January, concentrated from November to January depending on rainfall and stream discharge	December to May depending on time of entry
Spawning Period (resident populations)	Not Applicable	September to April	Not Applicable	Spring or early summer
Spawning Habitat				
Redd Sites	Pool tails or slightly upstream	Pool tails, upper sections of watershed	Pool tails or slightly upstream	Pools tails with protective cover nearby
Water Depth	0.2 to 0.5 m	0.1 to 1.5 m	0.5 to 7 m	0.1 to 1 m
Water Velocity	0.3 To 0.5 m/sec	0.2 to 1.6 m/sec	0.2 to 1.9 m/sec	0.1 to 1 m/sec
Substrate Size	1.3 to 15 cm	0.6 to 12.7 cm	1.3 to 15 cm	0.6 to 10.2 cm
Temperature	5.6^{o}C to 13.3^{o}C	5^{o}C to 15^{o}C	5.6^{o}C to 13.9^{o}C	5^{o}C to 15^{o}C
Incubation Period	36 to 100 days depending on water temperature	19 to 80 days depending on water temperature	30 to 159 days depending on water temperature	40 to 50 days depending on water temperature

TABLE 3.4-2
Key Life History and Habitat Requirements of Coho Salmon, Steelhead, Chinook Salmon, and Coastal Cutthroat Trout (from Table 3-1 of Simpson's proposed AHCP/CCAA)

Characteristic	Coho Salmon	Steelhead/Rainbow Trout	Chinook Salmon	Coastal Cutthroat Trout
Rearing Habitat	Mix of pools and riffles with abundant instream and overhead cover Fry seek shallow water along stream margins, backwaters, and side channels Summer parr found mainly in pools Overwintering juveniles seek shelter from high flows in side channels, backwaters, under large boulders and woody debris Summer weekly average temperatures (MWAT) below 17.4°C	Fry tend to school and seek shallow water along stream margins Larger fry and juveniles maintain territories in pool and run habitat Summer weekly average temperatures (MWAT) below 17.4°C (NMFS recommendation for coho)	Fry seek cover in shallow water along channel margins or in low-velocity channel bottoms Overwintering juveniles seek shelter under large boulders and woody debris, and in side channels or other low-velocity refugia Fry young-of-the-year and yearling smolts also use estuarine habitat Summer weekly average temperatures (MWAT) below 17.4°C (NMFS recommendation for coho)	Fry seek low-velocity shallow water in stream margins, backwater pools, and side channels Large coho fry can force cutthroat fry into riffles Summer weekly average temperatures (MWAT) below 17.4°C (NMFS recommendation for coho)
Outmigration (for anadromous populations)	Juveniles usually remain in freshwater for 1 year Smolts outmigrate from late March to early June	Freshwater residence varies from 1 to 4 years, but 1 to 2 years is predominant in the Project Area	Downstream migration begins immediately after emergence (Late Feb to June) Estuarine residence varies, probably 1 to 6 weeks depending on conditions	Anadromous cutthroat smolt outmigrate at 1 to 6 years of age depending on estuarine conditions

TABLE 3.4-2
Key Life History and Habitat Requirements of Coho Salmon, Steelhead, Chinook Salmon, and Coastal Cutthroat Trout (from Table 3-1 of Simpson's proposed AHCP/CCAA)

Characteristic	Coho Salmon	Steelhead/Rainbow Trout	Chinook Salmon	Coastal Cutthroat Trout
Other Factors	Coho spawn after spending 1 to 2 years at sea; in California, most coho spawn at 3 years of age, with some males spawning at age 2 (jacks) All coho die after spawning	Steelhead spawn after 1 to 4 years at sea Adult steelhead may spawn more than once Summer-run steelhead are able to use habitat not accessible to fall/winter-run salmonids Anadromous (steelhead) and resident (rainbow trout) populations occur in the Action Area	Chinook spawn at 2 to 7 years of age; in California, 2- to 4-year-olds are most common Some males (jacks) spawn at age 1 or 2 All chinook die after spawning	Resident and anadromous cutthroat use similar spawning habitat Non-migratory cutthroat live in isolated headwater tributaries Spawning tends to occur in 1st and 2nd order streams and isolated headwaters Cutthroat trout may spawn more than once

The anadromous (steelhead) and resident (rainbow trout) forms of *O. mykiss* are genetically indistinguishable, and the life history and habitat requirements of resident rainbow trout are similar to those of steelhead while in the freshwater phase.

Amphibians and Reptiles. Key life history and habitat requirements of the two amphibian species (southern torrent salamander and tailed frog) covered under the Proposed Action are summarized in Table 3.4-3 and discussed below under the individual species'

TABLE 3.4-3
Key Life History and Habitat Requirements of Southern Torrent Salamander and Tailed Frog
(from Table 3-2 of Simpson's proposed AHCP/CCAA)

Characteristic Habitat Requirements	Southern Torrent Salamander	Tailed Frog
General	Cold clear streams with a loose gravel substrate	Cold clear streams with a boulder, cobble, or gravel substrate
	Areas with water seeping through moss-covered gravel	Upper portions of streams but overlapping upper extent of fish-bearing reaches
	Splash zones of waterfalls	
	Uppermost portions of streams and headwater seeps	
Adults	Interstices within gravel in streams and under objects along stream edges and in splash zone	Streams and upland habitats along streambanks
	Usually remain within 1 m of flowing water	
Larvae	Interstices within gravel in streams	Attach selves to rocky substrates, primarily in riffles
Breeding Period	Spring or early summer	Spring and fall
Metamorphosis of Young	Probably 2 to 3 years	1 to 2 years (data specific to the Project Area)
Forage	Terrestrial and aquatic invertebrates	Terrestrial and aquatic invertebrates
		Tadpoles feed on diatoms
Other Factors	Can persist in streams with subsurface flow during the dry summer season	Predation by fish may limit distribution within lower sections of stream
	Generally are believed to have low dispersal capabilities	

descriptions. Amphibians breed in water and feed on land, in shrubs, or in trees. They occupy wetland, pond, riverine, and stream habitats as primary breeding areas. The general life history and habitat requirements of the additional amphibian species and the single reptile species that are only covered under Alternative C are summarized below under the individual species' descriptions.

Factors Affecting Populations

Water quality is an important habitat component for all fish species. Important water quality parameters for the covered salmonids and other fish species are temperature, sediment, and pollutants (Groot and Margolis, 1991; Rieman and McIntyre, 1993). Temperature affects fish growth, food supply, and the length of time required for egg incubation. Each life stage has preferred and optimal ranges of water temperature, with species' ranges often similar or overlapping. Activities that affect water temperature include those that reduce stream shading.

Stream sediment also is an important aspect of water quality. Too much sediment can result in stream-bottom embeddedness, which potentially limits the flow of well-oxygenated water among streambed gravels and cobbles. Reduced flow of well-oxygenated water through the stream bottom can affect egg incubation and survival, and the production of benthic invertebrates (insects), which are important fish foods (Groot and Margolis, 1991; Rieman and McIntyre, 1993).

Two other important factors can affect fish populations. These are the quantity and quality of physical habitat available and preferred by various species during different life stages, and the ability to access and use those habitats at different times of the year. Considerations include instream habitat characteristics, such as water depth and velocity, substrate, and the nature and complexity of overhead, shoreline, and bottom cover. Natural or artificial barriers that limit or prevent access to suitable habitat for spawning, rearing, migrations, and overwintering can adversely affect fish populations.

These same factors also directly or indirectly affect populations of the amphibian and reptile species covered under the various alternatives. In addition, since most species in this group breed exclusively in water, adjacent upland conditions have less of an impact on breeding habitat than riparian conditions. Additional information on each of the covered fish, amphibian, and reptile species is provided in the following text.

Status of Populations

NMFS published a proposed rule to list coho salmon as threatened in California and Oregon (July 25, 1995, 60 FR 38011). NMFS listed the SONCC coho salmon ESU as threatened (May 6, 1997, 62 FR 24588), and designated critical habitat for the SONCC coho salmon ESU (May 5, 1999, 64 FR 24049). This ESU extends from Cape Blanco, Oregon to Punta Gorda, California and overlaps the Primary Assessment Area. Critical habitat for the SONCC coho salmon ESU includes all river reaches accessible to listed coho salmon between Cape Blanco, Oregon and Punta Gorda, California, but excludes areas above specific dams or above longstanding, naturally impassable barriers. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and river reaches (including off-channel habitats). The State of California considers coho salmon from San Francisco Bay north to the Oregon border a candidate species for state listing. The location of coho salmon ESUs in the vicinity of the Simpson ownership is shown on Figure 3.4-1.

Life History and Habitat Requirements

Coho salmon typically exhibit a relatively simple, 3-year life history pattern. Adults begin freshwater spawning migrations in late summer and fall, spawn from September to March, concentrated in January and February, then die. Eggs incubate in gravels of spawning redds

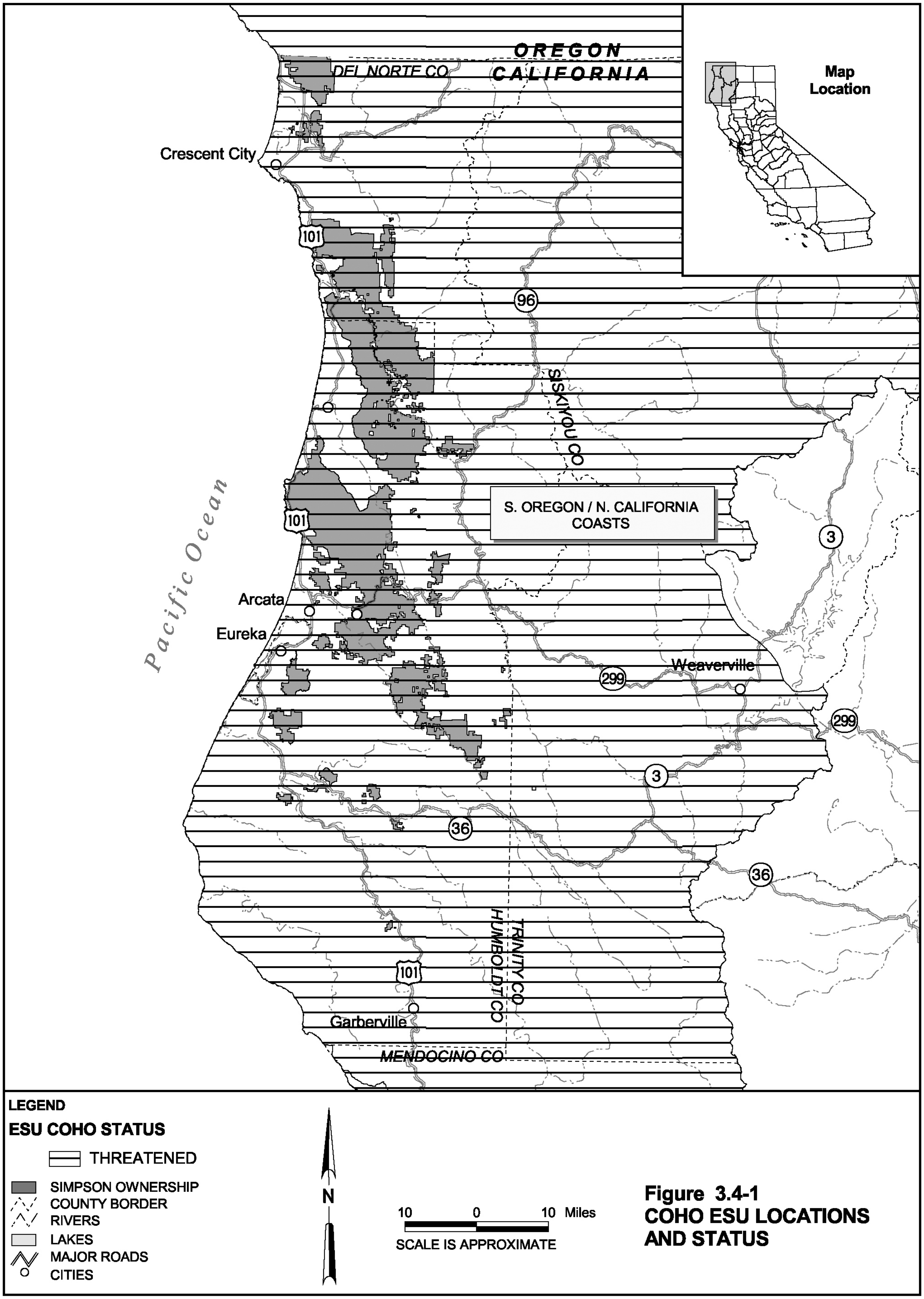


Figure 3.4-1
COHO ESU LOCATIONS AND STATUS

for about 1.5 to 4 months before hatching as alevins. Alevins soon emerge from the gravel as young juveniles and begin active feeding. Juveniles feed and grow in freshwater for up to 15 months before migrating to the ocean the following spring as 1+ age smolts. Juvenile coho salmon can rear for additional years in freshwater and outmigrate as 2+ or 3+ age smolts. Previous research found that all coho salmon in California outmigrate as 1+ smolts (Shapolov and Taft, 1954). In British Colombia and further north, coho salmon age 2+, and even age 3+ smolts are common (Sandercock, 1991). Recently, age 2+ coho outmigrants have been documented in Prairie Creek, California (Bell, 2001). Coho salmon generally rear for 2 years in the ocean before returning to their natal stream to spawn as 3-year old fish. A few may return to spawn after only 1 year in the ocean and are referred to as “jacks.” Table 3.4-2 summarizes key life history and habitat requirements for coho salmon.

Factors Affecting Populations

NMFS has identified numerous human-caused and natural factors it believes have contributed to declines of coho salmon (July 25, 1995, 60 FR 38011). Threats to the SONCC coho salmon ESU are numerous and varied. Several human-caused factors, including habitat degradation, harvest, and artificial propagation, exacerbate the adverse effects of natural environmental variability caused by drought, floods, and poor ocean conditions. NMFS reported the major activities responsible for the decline of coho salmon in Oregon and California are logging, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation (May 6, 1997, 62 FR 24588).

3.4.2.4 Chinook Salmon: California Coastal ESU, Southern Oregon and Northern California Coastal ESU, and Upper Klamath-Trinity Rivers ESU

Distribution

Native spawning populations of chinook salmon are distributed along the Asian coast from Hokkaido, Japan, to the Anadyr River, and along the North American coast from central California to Kotzebue, Alaska (Moyle, 1976; Allen and Hassler, 1986; Healey, 1991). Chinook salmon spawning may occur from near tidewater in coastal watersheds to over 3,200 km upstream in headwaters of the Yukon River (Major et al., 1978).

Status of Populations

NMFS listed the California Coastal chinook salmon ESU, which includes fall- and spring-run fish, as threatened (September 16, 1999, 64 FR 50394), and designated critical habitat for this ESU (February 16, 2000, 65 FR 7764). The California Coastal chinook salmon ESU includes chinook salmon populations from Redwood Creek in Humboldt County to the Russian River in Sonoma County, and, as such, overlaps the southern portion of the Primary Assessment Area. Designated critical habitat for this ESU includes all river reaches and estuarine areas accessible to listed chinook salmon from Redwood Creek to the Russian River, including adjacent riparian zones, but excluding tribal lands and areas above specific dams or above longstanding, naturally impassable barriers. Critical habitat consists of the water, substrate, and adjacent riparian zone of esturine and river reaches (including off-channel habitats).

On September 16, 1999, NMFS determined that listing the SONCC chinook salmon ESU was not warranted (64 FR 50394). The SONCC chinook salmon ESU extends from Cape Blanco, Oregon to the Lower Klamath River (inclusive) and, as such, overlaps the northern portion of the Primary Assessment Area. The SONCC chinook salmon ESU does not include chinook salmon populations in the Klamath River Basin upstream from the confluence of the Klamath and Trinity Rivers. Chinook salmon populations upstream of these rivers' confluence comprise the Upper Klamath-Trinity Rivers ESU, which overlaps the eastern portion of the Primary Assessment Area. NMFS determined on March 9, 1998, that listing the Upper Klamath-Trinity Rivers ESU was not warranted (63 FR 11482). The location of chinook salmon ESUs in the vicinity of the Simpson ownership is shown on Figure 3.4-2.

Life History and Habitat Requirements

Chinook salmon, like other salmon species, have complex life history characteristics and habitat needs because they are anadromous. Chinook salmon migrate extreme distances to spawn in the lower 48 states. The Primary Assessment Area only contains portions of rivers that are used for spawning and juvenile rearing by this species. Therefore, the following discussion of chinook salmon only addresses those life history aspects.

Adult chinook enter streams in the Primary Assessment Area from August through January. Spawning occurs in areas with clean large gravels, small cobbles, and sufficient flow to oxygenate eggs buried within the substrate. Spawning typically occurs in the fall, usually within 2 to 3 weeks after the fish reach their natal spawning grounds. Eggs incubate during the winter, then hatch from February through May. Fry remain in the gravel for about one month before emerging. Downstream migration begins immediately after emergence (late February to June). Estuarine residence varies from approximately 1 to 6 weeks, depending on conditions, before individuals move to the open ocean where they feed and rear (Moyle, 1976). Table 3.4-2 summarizes key life history and habitat requirements for chinook salmon.

Factors Affecting Populations

Because of their complex life history and range of habitat requirements, salmon can be subjected to a wide variety of environmental conditions (both natural and influenced by man) that affect their populations. These include conditions in the ocean, along freshwater migration corridors, and on their spawning grounds. Factors commonly associated with impacted salmon populations include genetic introgression from hatchery fish, ocean habitat conditions, suitability of spawning substrate (clean gravels and cobbles), water temperature, instream flows, and over-fishing.

Although several factors are likely to have improved conditions for chinook salmon in the California Coastal and SONCC chinook salmon ESUs, habitat alterations in the coastal river drainages have contributed to the reduction in abundance and distribution of chinook salmon in these ESUs. Examples of habitat alterations affecting chinook salmon include: water withdrawal, conveyance, storage, and flood control (resulting in insufficient flows, stranding, juvenile entrainment, and increased stream temperatures); and logging and agriculture (resulting in loss of large woody debris, sedimentation, loss of riparian vegetation, and habitat simplification) (Spence et al., 1996; Myers et al., 1998; NMFS, 1998).

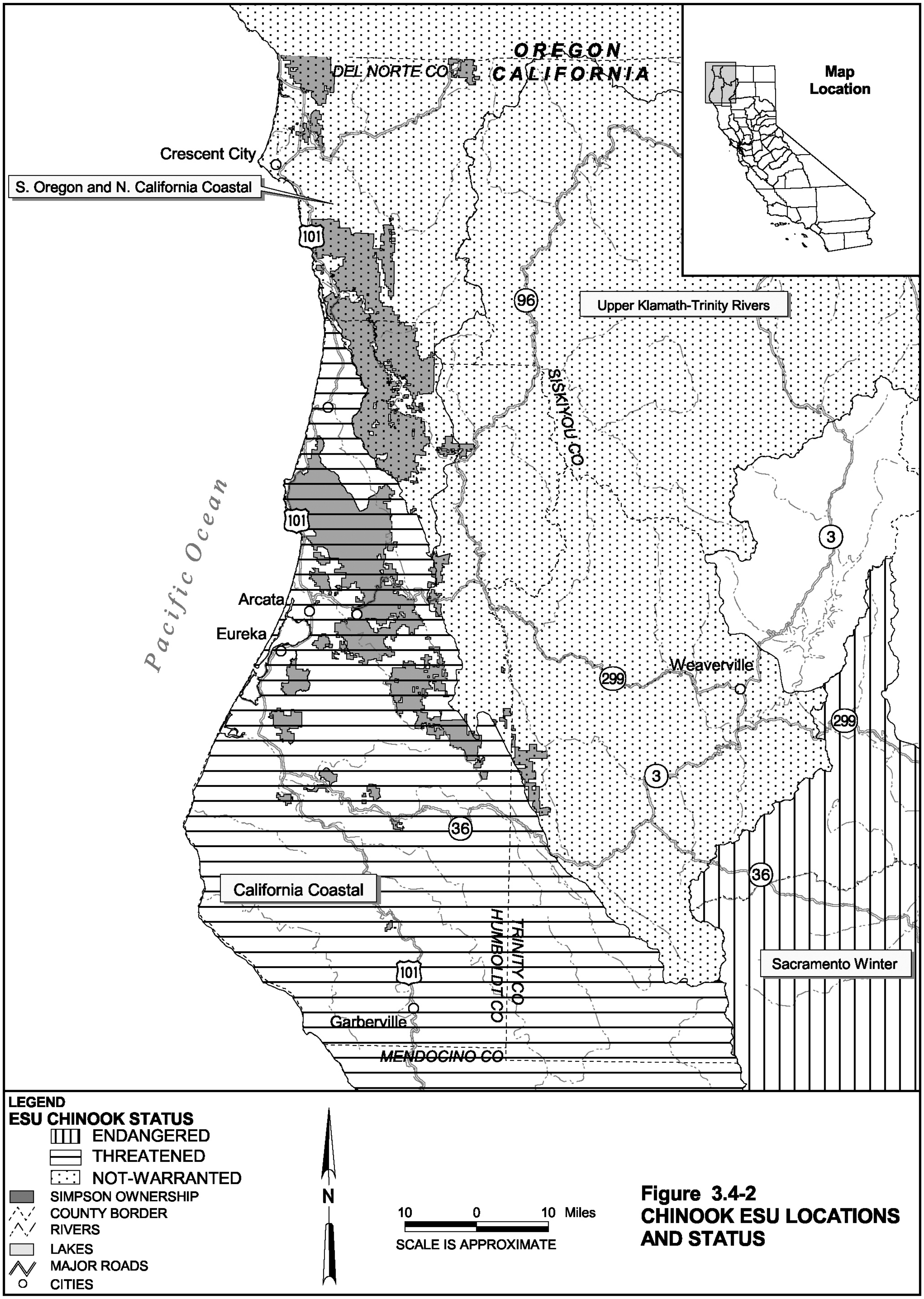


Figure 3.4-2
CHINOOK ESU LOCATIONS AND STATUS

3.4.2.5 Coastal Cutthroat Trout

Distribution

Coastal cutthroat trout are found in coastal drainages from the Eel River in northern California (Dewitt, 1954) to Prince William Sound in Alaska (Trotter, 1989). The inland limits of coastal cutthroat trout distribution are most likely the Fraser River in British Columbia and Celilo Falls on the Columbia River (Crawford, 1979; Trotter, 1989).

Status of Populations

NMFS determined that listing was not warranted for the Southern Oregon / California Coasts coastal cutthroat trout ESU (April 5, 1999, 64 FR 16397). This species is now formally under the jurisdiction of the USFWS. The USFWS is currently reviewing the status of cutthroat trout. Coastal cutthroat trout are a CDFG species of special concern and a USFS sensitive species (CDFG, 2001). All populations of coastal cutthroat trout in California are considered by some biologists to be at a moderate risk of extinction (Nehlsen et al., 1991).

Life History and Habitat Requirements

Coastal cutthroat trout can exhibit resident freshwater and anadromous life history forms, as indicated in the summary of key life history characteristics (Table 3.4-2). Resident populations spawn in the spring or early summer, with young fish emerging from the gravels from late spring through summer. Adults and juveniles use stream riffles and pool habitat for feeding and cover, respectively, and primarily pools and deep water habitat during winter. The resident form feeds primarily on aquatic insects, as opposed to the piscivorous (fish-eating) anadromous form (Wydoski and Whitney, 1979).

Anadromous coastal cutthroat trout exhibit a much different and more complex life history pattern than residents, because of their movements between freshwater and saltwater systems. The anadromous form spawns in smaller headwater streams and tributaries of coastal rivers to which they have access (Wydoski and Whitney, 1979). Spawning occurs primarily from late December to February, and young emerge from the gravels about mid-May. They remain in their natal streams for about a year before moving downstream to larger streams where they can live for 1 to 6 years. The anadromous form is quite piscivorous while rearing in freshwater (Behnke, 1992). Most outmigration to the ocean occurs from April through June (Wydoski and Whitney, 1979).

The life history and habitat requirements of coastal cutthroat while in saltwater are relatively unknown (Wydoski and Whitney, 1979). They do not appear to migrate to the open ocean, but instead use bays, estuaries, and the coastline where they feed on crustaceans and fish (Behnke, 1992).

Factors Affecting Populations

Behnke (1992) states that numbers of coastal cutthroat trout have drastically declined in many areas because of environmental alterations (mainly logging practices that result in increased sedimentation, reduced cover, and increased stream temperatures) and hybridization with non-native trout species. The NMFS and USFWS joint proposed rule for coastal cutthroat trout (April 5, 1999, 64 FR 16397) states that the present or threatened destruction, modification, or curtailment of its habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; inadequacy of existing regulatory mechanisms; and other natural or manmade barriers affecting its continued existence are the principle factors for decline across the range of coastal cutthroat trout.

3.4.2.6 Steelhead (Northern California ESU and Klamath Mountains Province ESU) and Resident Rainbow Trout

Distribution

Coastal rainbow trout are widely distributed from the Kuskokwin River in western Alaska to Baja California (Moyle, 1976; Behnke, 1992). Steelhead (the anadromous form) occur throughout the range of coastal rainbow trout except in the northern and southern extremities (Behnke, 1992). The present southern limit of steelhead distribution is Malibu Creek, California.

Status of Populations

Rainbow trout, the resident form, are under the jurisdiction of the USFWS and are currently unlisted. NMFS published a proposed rule to list steelhead in the Klamath Mountains Province ESU as threatened (March 16, 1995, 60 FR, 14253). NMFS subsequently determined that listing was not warranted for this ESU (March 19, 1998, 63 FR 13347). However, NMFS reproposed the Klamath Mountains Province steelhead ESU for listing as a threatened species because of concerns over specific risk factors (February 12, 2001, 66 FR 9808). It was subsequently determined that listing of the Klamath Mountains Province steelhead ESU was not warranted (April 4, 2001, 66 FR 17845). The Klamath Mountains Province steelhead ESU includes steelhead from the Elk River in Oregon to the Klamath and Trinity Rivers in California, inclusive, overlapping the Primary Assessment Area.

NMFS listed the Northern California steelhead ESU as threatened (June 7, 2000, 65 FR 36074), but has not yet designated critical habitat for this species. The Northern California steelhead ESU includes steelhead populations in California coastal river basins from Redwood Creek south to the Gualala River, inclusive. This ESU overlaps the Primary Assessment Area. The location of steelhead ESUs in the vicinity of the Simpson ownership is shown on Figure 3.4-3.

Summer-run steelhead from the Klamath Mountains Province ESU and the Northern California ESU are on CDFG’s list of species of special concern (CDFG, 2001). Currently, all runs of steelhead within this species’ southern limits (Malibu Creek, Santa Clara River, Ventura River, and Santa Ynez River) are considered at a high risk of extinction by many fisheries biologists (Nehlsen et al., 1991).

Life History and Habitat Requirements

Rainbow trout can exhibit resident freshwater and anadromous life history forms, as indicated in the summary of key life history characteristics in Table 3.4-2. Resident populations spawn from late summer through spring, with young fish emerging from the gravels in the spring and early summer. Steelhead (the anadromous form) generally rear for 2 years in freshwater before migrating to the ocean, where they typically spend two years before returning to freshwater to spawn. However, some individuals may spend 1 to 4 years at sea before reaching sexual maturity. Although steelhead are anadromous, they display different life history strategies than salmon. The most significant difference is that some steelhead survive spawning, return to the ocean for 1 or more years, then return to spawn again. Salmon only spawn once, then die.

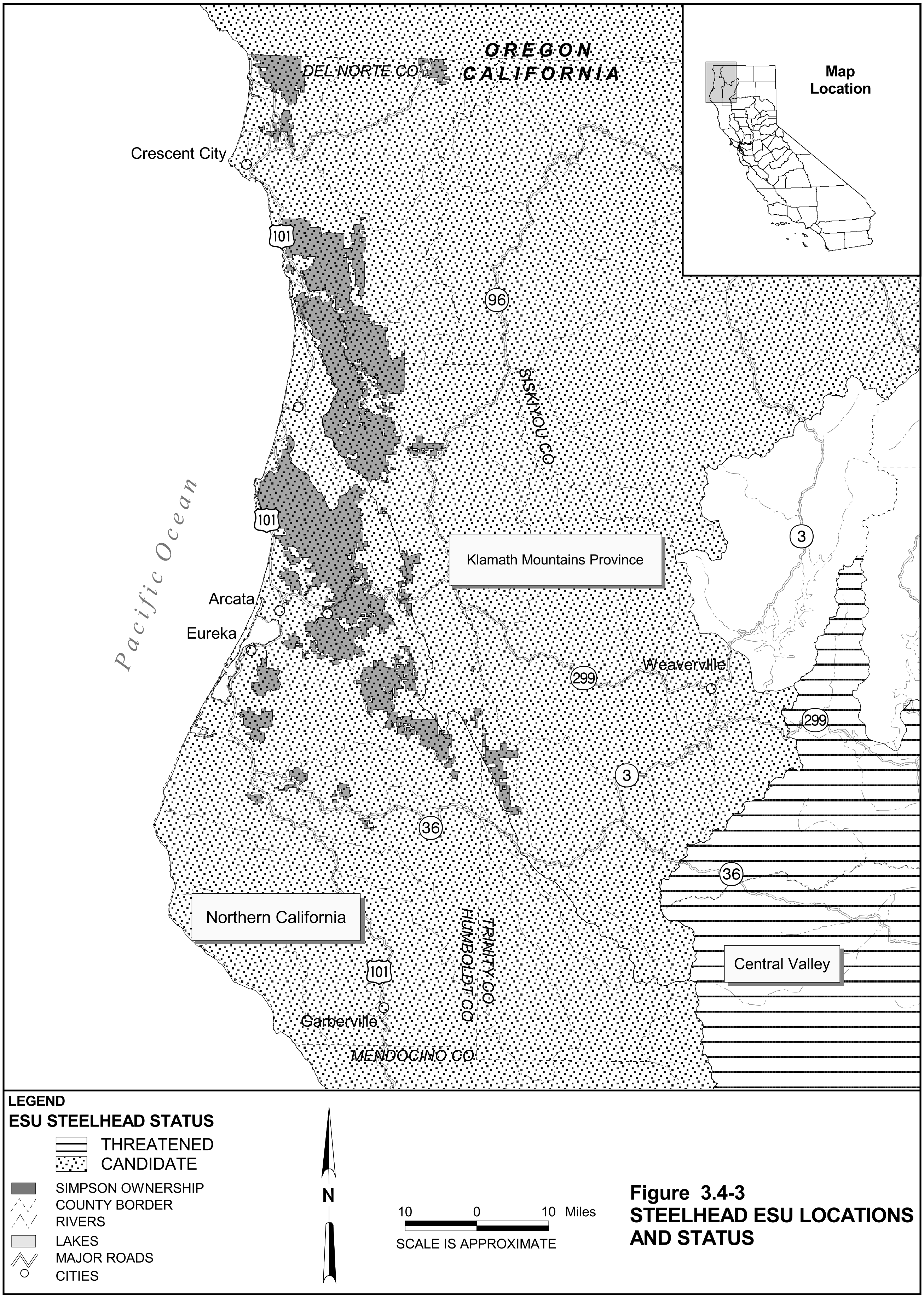


Figure 3.4-3
STEELHEAD ESU LOCATIONS AND STATUS

Steelhead consist of two reproductive types, based on (1) sexual maturity at the time they enter rivers for spawning, and (2) duration of their spawning migration (Busby et al., 1996). Stream-maturing steelhead are sexually immature when they enter freshwater rivers and require several months to mature and spawn. These fish are known as summer steelhead. The other type are ocean-maturing fish, which enter rivers sexually mature and spawn shortly after entering freshwater. These steelhead are referred to as winter steelhead.

Summer run steelhead are able to use habitat not accessible to fall/winter-run salmonids (Busby et al., 1996). Summer steelhead enter freshwater between May and October. Winter steelhead enter freshwater between November and April. Steelhead in the Primary Assessment Area spawn from September to March, depending on the time of entry. Redds are constructed in areas of coarse gravel and cobbles. Fry emergence occurs in late spring. Freshwater residence varies from 1 to 4 years, but 1 to 2 years is predominant in the Primary Assessment Area. Rearing steelhead tend to inhabit riffles and higher gradient habitats. Densities of juvenile steelhead in streams are greatest where there are good amounts of instream cover (Stoltz and Schnell, 1991).

The anadromous (steelhead) and resident (rainbow trout) forms are genetically indistinguishable, and the life history and habitat requirements of resident rainbow trout are similar to those of steelhead while in the freshwater phase (with the possible exception of estuary and some mainstem habitats). Table 3.4-2 summarizes key life history and habitat requirements for steelhead and rainbow trout.

Factors Affecting Populations

NMFS concluded that all of the factors identified in Section 4(a)(1) of the ESA have played a role in the decline of steelhead. Destruction and modification of habitat, overutilization for recreational purposes, and natural and human-caused effects are listed as the primary reasons for the decline of west coast steelhead populations (March 16, 1995, 60 FR 14253).

Steelhead populations have declined in abundance over the past several decades because of natural and human factors. Forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented habitat. Water diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat. Loss of habitat complexity also has contributed to steelhead declines. Sedimentation from land use activities is a primary cause of habitat degradation in the range of west coast steelhead (Busby et al., 1996).

Steelhead support an important recreational fishery. During times of decreased habitat availability (for example, during summer low flows when fish are concentrated), the impacts of recreational fishing on native anadromous stocks may increase. Incidental harvest mortality in mixed-stock sport and commercial fisheries may exceed 30 percent of listed populations. In addition, introduced non-native species and habitat modifications have led to increased predator populations in numerous river systems, and increased the level of predation on steelhead (Busby et al., 1996).

NMFS identified several factors they considered to have contributed to the decline of the Northern California steelhead ESU. These factors include impacts from historic flooding, predation, water diversions and extraction, minor habitat blockages, poaching, timber harvest, agriculture, and mining. Potentially adverse impacts from the release of nonindigenous, hatchery-produced steelhead in the ESU also were identified. These human-induced impacts in the freshwater ecosystem have likely reduced the species' resiliency to natural factors for decline, such as drought and poor ocean conditions (February 11, 2001, 65 FR 6960).

3.4.2.7 Tidewater Goby

Distribution

The tidewater goby is endemic to California and discontinuously distributed along the coast from Agua Hedionda Lagoon, in San Diego County, north to the mouth of the Smith River in Del Norte County (Moyle et al., 1995).

Status of Populations

The tidewater goby has been extirpated from nearly 50 percent of the lagoons within its historic range and faces threats indicating that this downward trend is likely to continue. The tidewater goby was listed as endangered under the federal ESA in 1994 (March 7, 1994, 59 FR 5494).

Life History and Habitat Requirements

The tidewater goby is found in shallow lagoons and lower stream reaches where waters are brackish to fresh and fairly slow moving. They avoid areas of strong current and wave action. Although its closest relatives are marine species, the tidewater goby lacks a marine life history phase. All life stages of tidewater gobies are found at the upper end of lagoons in salinities less than 10 parts-per-thousand. This species occurs in loose aggregations on the substrate in shallow water less than 3 feet deep. Eggs are deposited in vertical burrows excavated in clean, coarse sand. Larval gobies are found midwater around vegetation until they become benthic and begin feeding on small invertebrates and insect larvae.

Factors Affecting Populations

Coastal development projects that result in the loss of critical saltmarsh habitat are currently the major factor adversely affecting the tidewater goby (December 11, 1992, 57 FR 58770). Other factors contributing to the decline of the population include predation by exotic species and drought conditions combined with human-induced water reductions.

3.4.2.8 Southern Torrent Salamander

Distribution

The southern torrent salamander is one of four species in the genus *Rhyacotriton* and is the most southerly ranging. It is the only species of this genus that occurs in California. Southern torrent salamanders occur within the coastal conifer forest belt of northern California and southern Oregon, specifically from southern Mendocino County, California through the Coast Ranges, to the Little Nestucca River and the Grande Ronde Valley in Polk, Tillamook, and Yamhill Counties (Good and Wake, 1992). In California, this species is found in the coastal forests of northwestern California south to Mendocino County (Anderson, 1968). Bury and Corn (1988a) believed that these salamanders are distributed as isolated, discrete populations, especially in heavily managed or drier forests.

Status of Populations

On June 6, 2000, USFWS announced that, after review, the southern torrent salamander did not warrant listing as endangered or threatened. However, USFWS recommended that the species remain on the federal species of concern list.

The southern torrent salamander was a candidate for state listing as a threatened species. However, the California Fish and Game Commission ruled that this petition was not warranted and that CDFG should continue to consider the species as a species of special concern.

Life History and Habitat Requirements

Southern torrent salamanders have very specific habitat requirements of cold, shallow, flowing headwaters in humid coniferous forests (Nussbaum and Tait, 1977; Nussbaum et al., 1983; Diller and Wallace, 1996; Welsh and Lind, 1996). They are found most frequently in seeps, springs, and intermittent streams (Welsh, 1993) or in shallow water seeping through moss-covered gravel (Nussbaum et al., 1983). They appear to avoid open deep-water channels (Stebbins, 1985; Welsh, 1993). Adults are semiaquatic and are found next to larvae in streams, or under rocks or debris in saturated streamside habitats; larvae are aquatic and usually occur in loose gravel in streambeds (Nussbaum and Tait, 1977; Nussbaum et al., 1983). Southern torrent salamanders rarely move far from moist areas as they are very sensitive to dessication. Riparian areas are thought to be important to the species for foraging (Corn and Bury, 1989) and for courtship and reproduction (Nussbaum et al., 1983). Shade and high surface water availability are needed for movement within riparian areas. Table 3.4-3 summarizes key life history and habitat requirements for this species.

Factors Affecting Populations

The petition to list the southern torrent salamander cited habitat fragmentation, population declines, and inhibited dispersal capability throughout the species' range as significant threats to the species. Evidence indicates that timber harvesting and road building can negatively affect habitat for the southern torrent salamander. Direct effects of these activities include disturbance of substrate and killing of individual salamanders. Indirect effects include sedimentation of substrate used by the salamanders, increases in water temperatures to lethal levels, potential loss of permanent water flow, and potential increases in predator populations. The species' long lifespan may enable it to persist in marginal habitats until conditions improve. Southern torrent salamanders may also be able to burrow vertically in the substrate to find moist, cool conditions.

3.4.2.9 Tailed Frog

Distribution

The tailed frog is the only member of the genus *Ascaphus.* It is endemic to the Pacific Northwest and is widely distributed from northwestern California to British Columbia and western Montana (Nussbaum et al., 1983). Tailed frogs are found at elevations from sea level to near timber line throughout the coastal mountains from British Columbia south to Mendocino County and in the inland mountains of southeast Washington, Idaho, and Montana (Metter, 1968). In California, they occur from sea level to 6,500 feet elevation, mostly at sites receiving more than 40 inches of precipitation annually in Siskiyou, Del Norte, Trinity, Shasta, Tehama, Humboldt, Mendocino, and possibly Sonoma Counties (Bury, 1968). Throughout much of its range the species is distributed as disjunct populations (Metter, 1968). Bury and Corn (1988a) believed that isolated, discrete populations most likely occurred in drier forests and heavily managed lands.

Status of Populations

It currently is a federal species of concern and a CDFG species of special concern**.**

Life History and Habitat Requirements

Tailed frogs are found in and along small, swift, permanent, mountain streams with rocky substrates and low water temperatures buffered by dense vegetation (Nussbaum et al., 1983; Reichel and Flath, 1995; Daugherty and Sheldon, 1982). Streams supporting tailed frogs primarily occur in mature (Aubry and Hall, 1991) or old-growth coniferous forests (Bury, 1983; Bury and Corn, 1988a). More tailed frogs were observed in older Douglas fir-dominated, mixed conifer/hardwood forests near cold, clear, fast-flowing streams than in younger forests with the same type streams (Welsh, 1990). In the Coast Range of western Oregon, Corn and Bury (1989) found tailed frogs were more common in dense, moist, and young and mature forests, and absent from recent clearcuts. Tailed frogs tend to avoid wetlands, marshes, ponds, lakes, and slow, sandy-bottom streams (Daugherty and Sheldon, 1982). Table 3.4-3 summarizes key life history and habitat requirements of tailed frogs.

Factors Affecting Populations

Tailed frogs were considered rare for many years, but are now known to occur in high densities in suitable habitats (Nussbaum et al., 1983). Bury and Corn (1988a) and Welsh (1990) believed that long-term, range-wide reductions or extinctions of tailed frogs were likely caused by local extirpations, increased population fragmentation, habitat loss, restricted gene flow, and limited recolonization of streams when habitats are re-established. Although the survival of tailed frogs may depend on protection of cool flowing streams and adjacent forest habitats (Bury and Corn, 1988b), timber harvesting is not incompatible with such protection (Welsh, 1990). Bury and Corn (1988a) recommended establishing protection zones for tailed frogs by retaining deciduous and small (cull) trees around streams while felling merchantable timber away from the streams.

3.4.2.10 Foothill Yellow-Legged Frog

Distribution

The foothill yellow-legged frog is found west of the Oregon Cascades and south to Baja California, Mexico. Historically, this species was known to occur in most Pacific drainages from the Santiam River system in Oregon to the San Gabriel River system in Los Angeles County, California (Jennings and Hayes, 1994). In California, the foothill yellow-legged frog was historically distributed throughout the foothills of most drainages from the Oregon border to the San Gabriel River. This species is currently found throughout the northern and central Coast Ranges and Sierra Nevada foothills (Jennings and Hayes, 1994).

Status of Populations

The foothill yellow-legged frog has become absent from many locations where it was historically present in the Sierra Nevada foothills and southern portions of its range. The species is still abundant in many drainages in northwestern California and appears to still be distributed throughout its historic range. Jennings and Hayes (1994) described this species as endangered in central and southern California south of the Salinas River; threatened in the west slope drainages of the Sierra Nevada and southern Cascade Mountains east of the Sacramento and San Joaquin Rivers; and of special concern in the Coast Ranges north of the Salinas River. The foothill yellow-legged frog is considered a species of special concern and is fully protected by the State of California. This species also is a federal species of concern and is considered a sensitive species by the USFS.

Life History and Habitat Requirements

This species is typically associated with valley-foothill hardwood, valley-foothill hardwood-conifer, valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow habitat types (Zeiner et al., 1988). Foothill yellow-legged frogs are closely confined to the vicinity of permanent streams (Leonard et al., 1993) and intermittent streams (Hayes and Jennings, 1988). Shallow streams with a rocky substrate (at least cobble size) are preferred (Hayes and Jennings, 1988). Within streams with these characteristics, foothill yellow-legged frogs prefer riffles to other stream habitats (Hayes and Jennings, 1988). Foothill yellow-legged frogs appear to prefer streams with partial shading, often avoiding streams with very high (i.e., greater than 90 percent) or very low (i.e., less than 2 percent) stream shading (Hayes and Jennings, 1988). Females attach eggs to cobbles and boulders in shallow water where the eggs survive better than those laid in narrower and deeper channels. Kupferberg (1996) reported that most breeding sites were used repeatedly from year to year.

Factors Affecting Populations

The reduction in this species' distribution has been attributed primarily to dam building and flood control, mining, farming and canal building, urbanization (Jennings, 1988), and the introduction of aquatic predators (i.e., various fishes and bullfrogs) (Jennings and Hayes, 1994).

3.4.2.11 Northern Red-Legged Frog

Distribution

The northern red-legged frog is found in California, Oregon, Washington, and Canada (Nussbaum et al., 1983; Leonard et al., 1993). In California, this subspecies of red-legged frog is found west of the Cascade crest and as far south as Humboldt County. Northern red-legged frog and populations intermediate between northern and California red-legged frogs extend from Marin County north to the California/Oregon border (Jennings and Hayes, 1994).

Status of Populations

Declines in northern red-legged frog populations have been reported in British Columbia, Washington, and Oregon (Jennings and Hayes, 1994). Sufficient information has not yet been collected in California to assess overall population trends (Jennings and Hayes, 1994). The northern red-legged frog is considered a species of special concern and is fully protected by the State of California. This species also is a federal species of concern and is considered a sensitive species by the USFS.

Life History and Habitat Requirements

Most red-legged frogs are found in moist or wet forest areas and riparian habitats below 2,800 feet (Nussbaum et al, 1983), but they have been reported up to 4,680 feet (Leonard et al., 1993). During the non-breeding season, the red-legged frog is highly terrestrial and can be found up to 1,000 feet from water (Nussbaum et al., 1983). The red-legged frog feeds almost exclusively on land, along the water's margin, and in the vegetation (Licht, 1986), but it typically breeds in marshes, bogs, ponds, lakes, and slow-moving streams with dense streamside vegetation (Stebbins, 1972, Leonard et al., 1993). Studies by Aubry and Hall (1991) and Corn and Bury (1989) have shown the highest abundance in mature forest, with lower numbers in old-growth forest, young forest, and clearcuts. In addition, Aubry and

Hall (1991) found positive correlations between red-legged frog abundance and the density of broadleaf trees and percent cover of mid-canopy broadleaf trees.

Factors Affecting Populations

Little information is available concerning the causes for the observed decline of this subspecies, but bullfrog and exotic predatory fish introductions, pesticides, herbicides, coastal development, and timber harvesting have been implicated as contributing factors (Blaustein et al., 1995; Jennings and Hayes, 1994).

3.4.2.12 Western Pond Turtle

Distribution

The western pond turtle historically ranged nearly continuously in most Pacific drainages from Klickitat County, Washington to northern Baja California, Mexico, chiefly west of the Sierra-Cascade crest (Jennings and Hayes, 1994). In California, this species was historically present in most Pacific slope drainages between the Oregon and Mexican borders (Jennings and Hayes, 1994).

Status of Populations

Jennings and Hayes (1994) consider the western pond turtle to be threatened in California and endangered from the Salinas River south along the coast and inland from the Mokelumne River southward. Although the western pond turtle appears to still occur in most areas where it was reported historically, some populations are showing little or no recruitment. Substantial declines in western pond turtle numbers have been reported outside of California (see Jennings and Hayes, 1994). The western pond turtle is considered a species of special concern and is fully protected by the State of California. This species also is considered a federal species of concern and a sensitive species by the USFS.

Life History and Habitat Requirements

The western pond turtle has been described as an aquatic habitat generalist (Holland, 1991), but within the aquatic habitats used by the turtle, its distribution may vary seasonally and locally. The western pond turtle requires some slack-or slow-water aquatic habitat and inhabits a wide variety of fresh or brackish, permanent or intermittent water bodies. It typically occurs in marshes, lakes, ponds, brackish waters, slow-moving streams and rivers with adjacent vegetation mats, partially submerged logs, boulders, mudflats, and undercut banks and rootwads to serve as either basking or cover habitat (Blaustein et al, 1995). Habitats that lack these refugia are typically avoided by the turtle (Holland, 1994). Aquatic over-wintering sites are found along undercut banks and in soft mud of ponds (Holland, 1994). Western pond turtles can be sensitive to human disturbance, which can affect basking and nesting (Blaustein et al., 1995).

Western pond turtles use terrestrial habitats for nesting and hibernation (Holland, 1994). Mating occurs in April and May, and females move away from watercourses from June through August and migrate upslope to excavate nests up to 1,640 feet from the water’s edge (Rathbun et al., 1992). Females are very sensitive to disturbance during this time and may return to the watercourse if disturbed (Holland, 1994). Time spent in terrestrial habitats is variable, varying from locations in southern California where turtles have remained for two to three months to locations in Oregon where turtles have remained at overwintering sites for up to eight months. Overwintering sites generally have been located on slopes less than 35° in duff composed of conifer or broadleaf material (Holland, 1994). Hatchlings may overwinter in nest sites (Rathbun et al., 1992).

Factors Affecting Populations

Agricultural activities, urbanization, flood control, water diversion projects, and introduced predatory fish have contributed to population declines (Jennings and Hayes, 1994). Bullfrogs prey on hatchling and juvenile turtles and bass are known to prey on the smallest juveniles (Jennings and Hayes, 1994). Protection of suitable nesting habitat associated with existing populations and reduction in mortality of the younger age groups of turtles have been recommended to reverse the declining trend observed in western pond turtle populations (Jennings and Hayes, 1994).

3.4.3 Other Aquatic Resources

Other representative groups of aquatic resources present within the Primary Assessment Area and the additional 26,116 rain-on-snow acres under Alternative C besides the fish, amphibian, and reptile covered species described above include the following:

- Other native fish species such as lamprey, sturgeon, suckers, smelt, sculpins, and minnows
- Non-native (introduced) salmonids such as brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and hatchery-reared rainbow trout (*Oncorhynchus mykiss*)
- Non-native, non-salmonids such as sunfishes and bass
- A variety of aquatic invertebrates such as insects, crustaceans, clams, and snails

Numerous interactions can occur among these representative groups under existing conditions. Introduced salmonids can adversely affect some species of native salmonids by competing for space or food, or in some cases by preying on smaller life stages of native salmonids. For example, brook trout and brown trout can potentially compete for food and space with some life stages of native salmonids, and larger brown trout tend to be highly piscivorous in their diet. Native fishes, such as sculpin, provide a food source for native salmonids and introduced salmonids. All native aquatic species, including aquatic invertebrates, which are a major food source for most fish during all or parts of their lives, benefit from the same broad conditions that benefit the covered species. These conditions include cool, clean water and access to complex, diverse habitat.

3.4.4 Aquatic Habitat Conditions

This section provides descriptions of aquatic habitat conditions within the 11 HPAs previously discussed in Sections 3.2, *Geology, Geomorphology, and Mineral Resources*, and Section 3.3, *Hydrology and Water Quality*. These descriptions have been summarized from available information on the affected environment presented in Section 4 of Simpson's proposed AHCP/CCAA. HPAs encompassing complete drainage areas are referred to as hydrologic units, whereas those encompassing partial or multiple watersheds are referred to as hydrographic regions.

In general, the region encompassed by the 11 HPAs is characterized by the following:

- The steep and rugged terrane of the Coast Ranges and Klamath Mountains
- Geologic formations that range in age from pre-Jurassic to Recent and are marked by extensive folds and fault lines
- Several highly unstable geologic formations, including the Franciscan, Wildcat, and Falor formations
- Seasonally intense precipitation
- More than a century of logging, mining, road building, and grazing

Combined, these factors have altered stream conditions and increased hillslope erosion in most coastal watersheds. As a result of excess sedimentation and / or potential temperature concerns in several inland areas, the Klamath River, Redwood Creek, Mad River, Eel River, and Van Duzen River watersheds are included on the Section 303(d) list of impaired watersheds developed by the U.S. EPA and SWRCB (see Table 3.3-2 for a listing of 303(d) listed watersheds and pollutants).

Current habitat conditions and status of AHCP / CCAA covered aquatic species vary by HPA. Water temperatures in the HPAs are described in Section 3.3. Where data are available, current aquatic habitat conditions and status of AHCP / CCAA aquatic species are summarized below for the individual HPAs and the additional rain-on-snow areas outside of the HPAs that would be covered under Alternative C. Occurrence of covered species within the 11 HPAs for all project alternatives is summarized in Table 3.4-4.

3.4.4.1 Smith River Hydrographic Region

Channel and Estuary Conditions

Channel and habitat typing assessments have been conducted on 58 streams throughout the Primary Assessment Area. Four streams were examined within the Smith River Hydrographic Region: Wilson Creek, Dominie Creek, Rowdy Creek, and the South Fork Winchuck River (see Appendix C-1 of the AHCP / CCAA). Partitioning of habitat into pools, riffles, and runs showed a high percentage of riffles on Dominie Creek (51 percent) and the S.F. Winchuck River (41 percent), and a relatively even distribution of habitat types in the other two creeks. Dominie Creek had high levels of pool tailout embeddedness and shallow pool depths, while the other three creeks had low to moderate embeddedness and moderate to deep pools. Canopy density was relatively low on Rowdy Creek (63 percent) and higher on Wilson Creek, Dominie Creek, and S.F.Winchuck River (79 percent to 94 percent). The species composition of the riparian canopy was predominantly deciduous on all streams. Large woody debris (LWD) was not the dominant structural shelter component in any reach within the Smith River Hydrographic Region. Rowdy Creek and S.F. Winchuck River had only 5.6 percent and 6.4 percent LWD as shelter in pools, while Dominie Creek had 18.2 percent and Wilson Creek had 21.8 percent. Long-term channel monitoring is ongoing in two locations within the Smith River Hydrographic Region. Monitoring began on the South Fork Winchuck in 1996 and on Wilson Creek in 1998. No conclusions can be drawn at this point from the monitoring.

A LWD inventory was conducted in 20 streams throughout the Primary Assessment Area in 1994 and 1995, including four streams within the Smith River Hydrographic Region: Rowdy

TABLE 3.4-4
Occurrence of Species Covered Under Project Alternatives in Hydrographic Planning Areas

Species	Smith River	Coastal Klamath	Blue Creek	Interior Klamath	Redwood Creek	Coastal Lagoons	Little River	Mad River	NF Mad River	Humboldt Bay	Eel River
Fish											
Chinook salmon	K	K	K	K	K	K	K	K	K	K	K
Coho salmon	K	K	K	K	K	K	K	K	K	K	K
Steelhead	K	K	K	K	K	K	K	K	K	K	K
Rainbow trout	K	K	K	K	K	K	K	K	K	K	K
Cutthroat trout	K	K	K	K	K	K	K	K	K	K	K
Tidewater goby	K	P	N	N	P	K			N	K	P
Amphibians and Reptiles											
Tailed frog	K	K	K	K	K	K	K	K	K	K	K
Southern torrent salamander	K	K	K	K	K	K	K	K	K		K
Foothill yellow-legged frog	K	K	K	K	K	K	K	K	K	K	K
Northern red-legged frog	K	K	K	K	K	K	K	K	K	K	K
Western pond turtle	P	K	K	K	K	P	K	K	K	P	P

K Known
P Presumed
N Does not occur
blank unknown

Creek, Dominie Creek, South Fork Winchuck River, and Wilson Creek (see Appendix C-2 of the AHCP/CCAA). There was a moderate level of both inchannel and recruitment zone LWD, but the size of the in-channel LWD was predominantly small (less than 2 foot diameter), reflecting the alder-dominant riparian zones prevalent throughout the Primary Assessment Area. The lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote formation of pools. Stream health in the Smith River Hydrographic Region would benefit from increased abundance of large diameter and length LWD.

The Winchuck River estuary has been impacted by a reduction of habitat through channelization for livestock grazing. The mouth of the Winchuck River regularly bars over during the summer to form an enclosed estuary. This estuary is occupied by juvenile chinook salmon and coastal cutthroat trout during the summer months. The estuary habitat for rearing salmonids is limited because of both a lack of depth and LWD for protective cover and avian predator avoidance. Efforts are underway by the Oregon Department of Fish and Wildlife to enhance the rearing habitat in the Winchuck River estuary.

The lower channel and estuary of the Smith River has been altered and simplified by agriculture, livestock grazing, gravel mining, and urban development. The loss of secondary channels, sloughs, backwaters, and LWD has reduced the amount and complexity of salmonid rearing habitat. The Smith River mouth generally remains open and fails to bar over to form an enclosed estuary.

The lower section of the Wilson Creek watershed lacks an estuary. The creek runs directly into a semi-protected section of coastline where wave action at the creek's entrance is cushioned by exposed rocks. Flow in the lower channel is intermittent during the summer, thus out-migrating salmonid smolts have a discrete window in which to leave the watershed.

Species Status

The Smith River Hydrographic Region is in the Southern Oregon and Northern California Coastal ESU for chinook salmon, which NMFS determined does not warrant listing (September 16, 1999, 64 FR 50394). Juvenile chinook production is thought to be increasing in the Winchuck River. The Smith River has the only known spring-run chinook population in the Northern California Coastal chinook ESU. Chinook are well distributed in smaller coastal streams in the SONCC chinook salmon ESU, and recent increases in abundance have been noted in these smaller coastal streams (September 16, 1994, 64 FR 50394).

Coho salmon populations are depressed throughout the SONCC ESU, which includes the Smith River Hydrographic Region. Current abundance in the California portion of this ESU is thought to be less than 6 percent of the abundance in the 1940s (Weitkamp et al., 1995). The SONCC coho salmon ESU was listed as threatened under the ESA on May 6, 1997 (62 FR 24588). Spawner surveys and outmigrant trapping on Mill Creek, tributary to the Smith River, indicate that Mill Creek supports an abundant coho run (Howard, unpubl. data). Recent surveys of coho salmon conducted by Simpson (both spawner/carcass and juvenile counts) in the South Fork Winchuck River and Wilson Creek indicate that runs in both streams are low and variable. The annual estimate of juvenile coho salmon in Wilson Creek has varied widely from less than 20 to nearly 1,400 juveniles during the

1995-2000 period. Coho estimates in the South Fork Winchuck River have been much lower than those in Wilson Creek over the same period (see Appendix C-7 of the AHCP/CCAA).

The Smith River Hydrographic Region is within the Klamath Mountains Province ESU for steelhead, which was determined to not warrant listing as of April 4, 2001 (66 FR 17845). Steelhead populations in the Winchuck River were assessed as "Healthy" by ODFW/CDFG (Nickelson et al., 1992). Smith River fall-run steelhead were considered "Healthy" by ODFW/CDFG but summer-run fish were considered at high risk of extinction by Nehlsen et al. (1991) and as depressed by the USFS (from Busby et al., 1994). Annual juvenile steelhead population estimates at Wilson Creek and the South Fork Winchuck River are highly variable, ranging from a few hundred to more than 3,000 during the 1995-2000 period (see Appendix C-7 of the AHCP/CCAA).

Coastal cutthroat trout are now formally under the jurisdiction of the USFWS and are undergoing a status review. Cutthroat trout populations in southern Oregon and northern California are thought to be widely distributed in many small populations, with the exception of the Rogue and Smith Rivers, which support large and healthy populations (Johnson et al., 1999).

The Smith River is considered California's most important producer of coastal cutthroat trout. Cutthroat trout abundance trends in the Smith River increased 1 percent to 5 percent annually from 1982 to 1998 (Johnson et al., 1999). In addition, smolt abundance in Mill Creek (tributary to the Smith River) has increased during years 1994 though 1997 (Howard and Albro, 1997). Habitat in the Smith River estuary has been substantially degraded and cutthroat trout populations in the estuary are very low compared to historical estimates (Gerstung, 1997). Smolt counts in the Winchuck River from 1996 to 1998 show high variation, but the numbers trapped are encouraging, showing increases from 1,400 to 2,800 during this time period (Johnson et al., 1999). Cutthroat trout population estimates in the South Fork Winchuck have remained relatively stable at approximately 400 to 500 juveniles during the 1996 to 2000 period. No cutthroat were observed in Wilson Creek in 1997 and 1999 and estimates have ranged from less than 20 to approximately 160 in other years (see Appendix C-7 of the AHCP/CCAA).

Simpson conducted presence/absence surveys for tailed frogs in this HPA as part of a sampling of 72 streams throughout the entire Action Area to estimate the proportion of streams that supported populations of tailed frogs (Diller and Wallace 1999). In the Smith River Hydrographic Region, eight of eight (100 percent) streams sampled as part of presence/absence surveys had tailed frogs. In addition, populations of tailed frogs were confirmed in 27 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and the large number of streams known to support the species, tailed frogs streams in the Smith River Hydrographic Region appear to be in excellent condition.

Simpson conducted presence/absence surveys for southern torrent salamanders in this HPA as part of a sampling of 71 streams throughout the entire Action Area to estimate the proportion of streams that supported populations of southern torrent salamanders (Diller and Wallace 1996). In the Smith River HPA, seven of seven (100 percent) streams sampled as part of presence/absence surveys had torrent salamanders. In addition, populations of torrent salamanders were confirmed in 68 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, southern torrent salamander streams in the Smith River Hydrographic Region appear to be in excellent condition.

3.4.4.2 Coastal Klamath Hydrographic Region

Channel and Estuary Conditions

Twenty-two creeks were examined within the Coastal Klamath Hydrographic Region, 6 by Simpson personnel and 16 by the Yurok Tribal Fisheries Program (YTFP) (see Appendix C-1 of the AHCP/CCAA). Canopy closure was relatively high (from 76 to 97 percent) in the 22 creeks assessed with the exception of Terwer and East Fork Terwer Creek, which were recovering from an extremely hot wildfire in 1988 and had canopy closure of 36 percent and 71 percent, respectively. The riparian canopy was primarily deciduous (from 73 percent to 97 percent) along all the creeks assessed. The percentage of LWD as the dominant structural shelter component in pools varied widely within the Coastal Klamath Hydrographic Region from a low of 6.8 percent in East Fork Terwer Creek to a high of 55.1 percent in East Fork Hunter Creek. The average value for the 22 creeks was 26.3 percent. Partitioning of habitat into pools, riffles, and runs showed a high percentage of riffles on Bear Creek (58 percent) and South Fork Ah Pah Creek (46 percent). Of the 22 assessed creeks, 17 had sections of dry channel, ranging from 1 percent to 86 percent of the total length surveyed. Mynot, Hunter, EF Hunter, Hoppaw, and Main Stem Ah Pah Creeks had the most dry channel, all with over 24 percent of the total length in dry channel. Omagar Creek had 23 percent of the total length in culverts.

Fourteen of the 22 creeks assessed had high pool tailout embeddedness values (60 percent or more of pool tailouts reported as at least 50 percent embedded). Fourteen of the 22 creeks had predominantly (greater than 50 percent) shallow (less than 2 feet) pools.

Long-term channel monitoring is ongoing at four locations within the Coastal Klamath Hydrographic Region: two sites on Hunter Creek, and one site each on Hoppaw Creek and Tectah Creek. Monitoring began in 1996 on one site in Hunter Creek and in 1997 at the other three sites. No conclusions can be drawn at this point from the monitoring.

A LWD inventory was conducted during 1994 and 1995 in five streams within the Coastal Klamath Hydrographic Region: Hunter Creek, Terwer Creek, the North and South Forks of Ah Pah Creek, and Ah Pah Creek (see Appendix C-2 of the AHCP/CCAA). The mainstem and North and South Forks of Ah Pah Creek had some of the highest amounts of LWD of all the creeks surveyed in the Primary Assessment Area. Overall, there was a moderate level of both in-channel and recruitment zone LWD, but the size of the in-channel LWD was predominantly small (1 to 2 feet in diameter), reflecting the alder-dominant riparian zones prevalent throughout the Primary Assessment Area. The lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote formation of pools. Stream health in the Coastal Klamath Hydrographic Region would benefit from increased abundance of large diameter and length LWD.

Like most northcoast watersheds, the Klamath River estuary has been impacted by human activities. The lower channel has lost some its wetland habitat to residential development. The estuary has been degraded by excessive sedimentation from the upper basin. The lower channel was also extensively cleared of snags and large woody debris at the turn of the century for commercial gillnetting and navigational purposes. Water diversions from the upper Klamath and Trinity Rivers affects the water quality of the estuary during summer months and probably contribute to the occasionally high water temperatures. Even with a large volume of flow, the Klamath River mouth periodically bars over and backfloods the lower river for several miles.

Species Status

Like the Smith River Hydrographic Region, the Coastal Klamath Hydrographic Region is in the SONCC ESU for chinook, which NMFS has determined does not warrant listing (September 16, 1999, 64 FR 50394). Within this ESU, chinook are well distributed in smaller coastal streams, and recent increases in abundance have been noted in these smaller coastal streams (September 16, 1999, 64 FR 50394). Chinook escapement in the Klamath Basin is greatly reduced from historic estimates and current escapement levels are dependent on hatchery production (Voight and Gale, 1998).

Coho populations are depressed throughout the SONCC ESU for coho salmon, which includes the Coastal Klamath Hydrographic Region. The SONCC coho salmon ESU has been listed as threatened under the ESA (May 6, 1997, 62 FR 24588). Coho runs in the Klamath Basin are greatly diminished from historical estimates and are largely hatchery supported today, although small wild runs exist in some tributaries (Weitkamp et al., 1995). Juvenile coho were present in 8 of 12 tributaries sampled by the YTFP within the Coastal Klamath Hydrographic Region in 1996, but were generally scarce and narrowly distributed within these tributaries (Voight and Gale, 1998). The ratio of wild fish to hatchery fish spawning naturally in these tributaries is unknown.

The Coastal Klamath Hydrographic Region is within the Klamath Mountains Province ESU for steelhead, which was determined to not warrant listing (April 4, 2001, 66 FR 17845). Specific information on steelhead in the Coastal Klamath Hydrographic Region is limited. YTFP sampling found juvenile steelhead to be well distributed in Coastal Klamath tributaries (100 percent presence, n=12 tributaries sampled), but no estimates of abundance were made (Voight and Gale, 1998). Steelhead populations in the Klamath River as a whole are significant, (summer/fall-run size of 110,000 fish, winter-run size of 20,000 fish) but believed to be largely hatchery supported (Busby et al., 1994).

Coastal cutthroat trout are now formally under the jurisdiction of the USFWS and are undergoing a status review. Short-term trends indicate increases in adult cutthroat trout abundance in the lower Klamath River and its tributaries (Johnson et al., 1999). The YTFP found juvenile coastal cutthroat trout to be well distributed and relatively abundant in Coastal Klamath Hydrographic Region tributaries (present in 10 of 12 tributaries sampled). However, the dominance and abundance of (presumably) resident cutthroat in areas above barriers to anadromy could mask declines in anadromous sea-run coastal cutthroat trout populations (Voight and Gale, 1998).

In the Coastal Klamath Hydrographic Region, 16 of 17 (94.1 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in 26 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, tailed frogs streams in the Coastal Klamath Hydrographic Region seem to be in excellent condition.

In the Coastal Klamath Hydrographic Region, 15 of 16 (93.8 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 81 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, southern torrent salamander streams in the Coastal Klamath Hydrographic Region appear to be in excellent condition.

3.4.4.3 Blue Creek Hydrologic Unit

Channel and Estuary Conditions

Simpson has not conducted any channel and habitat typing assessment in the Blue Creek Hydrologic Unit. The YTFP has conducted channel and habitat typing on four streams in the Blue Creek Hydrologic Unit: mainstem Blue Creek, West Fork Blue Creek, Potato Patch Creek, and Slide Creek (see Appendix C-1 of the AHCP/CCAA). Canopy density was high on West Fork Blue Creek (87 percent) and Potato Patch Creek (95 percent), but low on main stem Blue Creek and Slide Creek (42 percent and 38 percent, respectively). The riparian canopy was predominantly deciduous, ranging from 66 to 91 percent in three of the four creeks. Riparian canopy was predominantly conifers on Slide Creek. LWD was a very small component of structural shelter in pools, with values varying from 1.5 to 6 percent in the surveyed creeks. Partitioning of habitat into pools, riffles, and runs showed a high (49 percent) percentage of riffles on West Fork Blue Creek and mainly flatwater and pools on the other three creeks.

Blue Creek and Slide Creek had low levels of pool tailout embeddedness, while more than 55 percent of pool tailouts in West Fork Blue and Potato Patch Creeks were at least 50 percent embedded. Blue Creek had predominantly deep pools (greater than 4 ft), while pools in the other three creeks were mostly less than 3 feet deep. No long-term channel monitoring have been conducted by Simpson in this HPA.

An LWD inventory was conducted during 1994 and 1995 in one stream within the Blue Creek Hydrologic Unit (see Appendix C-2 of the AHCP/CCAA). The number of instream LWD pieces per 100 feet of channel in West Fork Blue Creek (3.2) was somewhat greater than in other streams with similar watershed areas in the Primary Assessment Area.

Species Status

The Blue Creek Hydrologic Unit is in the SONCC ESU for chinook salmon, which NMFS has determined does not warrant listing (September 16, 1999, 64 FR 50394). Blue Creek chinook salmon populations have been monitored by the USFWS (1988 to 1992) and are currently monitored by the YTFP. Chinook escapement in the Klamath Basin is greatly reduced from historic estimates, but Blue Creek has a significant chinook population that showed variable but overall increasing trends in both adult escapement and juvenile outmigrant abundance from 1988 to 1996. (Gale et al., 1998). Compared with other non-hatchery enhanced tributaries with similar drainage areas, Blue Creek chinook are thought to be a significant component of the wild chinook run in the Klamath Basin (Gale et al., 1998).

Coho populations are depressed throughout the SONCC ESU for coho salmon, which includes the Blue Creek Hydrologic Unit. The SONCC coho salmon ESU has been listed as threatened under the ESA (May 6, 1997, 62 FR 24588). The Blue Creek Hydrologic Unit is somewhat unique in that it supports a significant population of native coho salmon with no evidence of hatchery produced fish in a river system otherwise characterized by heavy hatchery production and planting within many tributaries (Weitkamp et al., 1995, Gale et al., 1998). Estimates and trends in spawner escapements are hampered by low numbers of spawners and the difficulty in enumerating adult coho salmon, especially during high flow / poor visibility conditions. Qualitative snorkeling surveys indicate that portions of the Blue Creek Hydrologic Unit (especially the Crescent City Fork) have ideal spawning and rearing habitat for coho, and juvenile coho were observed utilizing this habitat in high densities (Gale et al., 1998).

The Blue Creek Hydrologic Unit is within the Klamath Mountains Province ESU for steelhead, which was determined to not warrant listing (April 4, 2001, 66 FR 17845). The Blue Creek Hydrologic Unit has ideal habitat for steelhead, and is thought to contain a large population of winter-run steelhead as well as a small number of summer-run steelhead. Snorkel surveys found juvenile steelhead to be abundant and well distributed throughout Blue Creek (Gale et al., 1998).

Coastal cutthroat trout are now formally under the jurisdiction of the USFWS and are undergoing a status review. Short-term trends indicate increases in adult cutthroat trout abundance in the lower Klamath River and its tributaries (Johnson et al., 1999). The YTFP reports that Blue Creek supports a small population of coastal cutthroat trout (Gale et al., 1998).

In the Blue Creek Hydrologic Unit, two of three (66.7 percent) streams sampled as part of presence / absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in seven other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. This HPA is very similar to the Coastal Klamath Hydrographic Region, which appears to have excellent habitat for tailed frogs.

In the Blue Creek Hydrologic Unit, four of four (100 percent) streams sampled as part of presence / absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 32 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. This HPA is very similar to the Coastal Klamath Hydrographic Region, which appears to have excellent habitat for torrent salamanders.

3.4.4.4 Interior Klamath Hydrographic Region

Channel and Estuary Conditions

Simpson has not conducted any channel and habitat typing assessments in the Interior Klamath Hydrographic Region. The YTFP has conducted channel and habitat typing on 11 streams in the Interior Klamath Hydrographic Region: Johnson, Pecwan, East Fork Pecwan, Mettah, South Fork Mettah, Roach, a tributary to Roach, Morek, Cappel, Tully, and Robbers Creeks (see Appendix C-1 of the AHCP / CCAA). Canopy density ranged from 74 percent to 94 percent in the creeks surveyed. The riparian canopy was predominantly deciduous in all 11 creeks. Morek and Cappel Creeks had the greatest amount of conifer canopy (34 and 41 percent, respectively). The percent of LWD as a component of structural shelter in pools ranged from 1.7 percent in Pecwan Creek to 19.9 percent in South Fork Mettah Creek. The average value was 9.2 percent. Partitioning of habitat into pools, riffles, and flatwater showed that pools and flatwater comprised more than 70 percent of the total length in all ten creeks surveyed. Six streams had sections of dry channel, ranging from 1 percent in Robbers Creek to 13 percent in Johnson and Morek Creeks.

Ten of the streams assessed had high levels of pool tailout embeddedness (greater than 75 percent of pools at least 50 percent embedded). Tully Creek was the one exception. At least 50 percent of the pools in six creeks were greater than 2 feet deep, while Johnson, Mettah, South Fork Mettah, and the Roach Creek tributary Creeks exhibited mainly shallow pools (less than 2 feet deep). No long-term channel monitoring or LWD surveys have been conducted by Simpson in this HPA.

Species Status

The Interior Klamath Hydrographic Region is in the SONCC chinook salmon ESU, which NMFS determined does not warrant listing as of September 1999 (64 FR 50394). Specific information on chinook salmon in the Interior Klamath Hydrographic Region is limited. Chinook escapement in the Klamath Basin is greatly reduced from historic estimates and current escapement levels are dependent on hatchery production (Voight and Gale, 1998). Portions of this HPA also overlap with the Upper Klamath-Trinity Rivers ESU chinook salmon, which NMFS has also determined does not warrant listing (63 FR 11482).

Coho salmon populations are depressed throughout the SONCC ESU, which includes the Interior Klamath Hydrographic Region. The SONCC coho salmon ESU has been listed as threatened under the ESA (May 6, 1997, 62 FR 24588). Specific information on coho salmon in the Interior Klamath Hydrographic Region is limited. Recent sampling (1996) by the YTFP observed low numbers of juvenile coho in two of three tributaries that have historically been reported to have coho (Voight and Gale, 1998).

The Interior Klamath Hydrographic Region is within the Klamath Mountains Province steelhead ESU for steelhead, which NMFS determined does not warrant listing as of April 4, 2001 (66 FR 17845). Attempts to assess the population status of steelhead in this ESU are hampered by a lack of biological information. In general, there has been a replacement of naturally produced fish with hatchery fish, and downward trends in abundance in most populations (Busby et al., 1994). Specific steelhead population abundance estimates for streams within the Interior Klamath Hydrographic Region are generally non-existent. YTFP sampling (1996) found juvenile steelhead are well-distributed in Interior Klamath tributaries (100 percent presence, n=4 tributaries sampled), but no estimates of abundance were made (Voight and Gale, 1998).

Coastal cutthroat trout are now formally under the jurisdiction of the USFWS and are undergoing a status review. Specific information on coastal cutthroat trout populations in the Interior Klamath Hydrographic Region is almost non-existent. The YTFP found coastal cutthroat in one of four Interior Klamath Hydrographic Region tributaries surveyed in 1996 (Gale et al., 1998). Gerstung (1997) suggests that coastal cutthroat trout typically do not occur above Mettah Creek.

In the Interior Klamath Hydrographic Region, seven of 11 (63.6 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in five other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this moderate rate of occurrence and relatively small number of streams known to support the species, tailed frogs streams in the Interior Klamath Hydrographic Region appear to be in moderate condition.

In the Interior Klamath Hydrographic Region, 10 of 11 (90.9 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 56 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, southern torrent salamander streams in the Interior Klamath Hydrographic Region appear to be in excellent condition.

3.4.4.5 Redwood Creek Hydrologic Unit

Channel and Estuary Conditions

No channel or habitat typing assessments, long-term channel monitoring or LWD surveys have been conducted by Simpson in this HPA. After the flood of 1964, which inundated the town of Orick with five feet of water, the U.S. Army Corps of Engineers (Corps) constructed a levee from Prairie Creek to the ocean. During low summer flows, the north and south sloughs of the estuary become isolated and anoxic. The lower three miles of Redwood Creek also are devoid of riparian vegetation and LWD because the Corps requires that the levee's channel be clear of debris, that may lessen its transport capacity.

Species Status

The Redwood Creek Hydrologic Unit is the northernmost boundary of the California Coastal ESU for chinook salmon, which was listed as threatened under the ESA on September 16, 1999 (64 FR 50394). Low abundance levels, sporadic occurrence in some river systems, and negative long term trends in abundance were cited in the decision to list the California Coastal chinook salmon ESU as threatened (September 16, 1999, 64 FR 50394). Specific information on chinook in the Redwood Creek Hydrologic Unit is limited. Nehlsen et al. (1991) characterized fall-run chinook in Redwood Creek as at "moderate risk of extinction," and a reanalysis by Higgins et al. (1992) resulted in an upgrade in status to "stocks of special concern."

Coho salmon populations are depressed throughout the SONCC ESU, which includes the Redwood Creek Hydrologic Unit. Current coho salmon abundance in the California portion of this ESU is thought to be less than 6 percent of their abundance in the 1940s (Weitkamp et al., 1995). The SONCC coho ESU has been listed as threatened under the ESA as of May 6, 1997 (62 FR 24588).

The Redwood Creek Hydrologic Unit is the northern boundary of the Northern California ESU for steelhead, which was listed as threatened June 7, 2000 (65 FR 36074). Steelhead abundance data is very limited for this ESU, but available data indicates that winter-run steelhead populations declined significantly prior to 1970, and populations have remained at depressed levels with no clear trends since then. Nehlsen et al. (1991) identified summer steelhead in Redwood Creek as "at risk of extinction." NMFS found that for the seven populations of steelhead within this ESU only the small summer steelhead population within the Mad River, which has had large supplemental production from hatchery sources, and Prairie Creek winter steelhead have shown recent trends of increasing abundance (June 7, 2001, 65 FR 36074). Prairie Creek is a tributary to Redwood Creek and as such is within the Redwood Creek Hydrologic Unit.

Redwood Creek historically supported a large population of anadromous coastal cutthroat trout. The current population is thought to be very depressed compared to historical estimates, but relatively stable (Gerstung, 1997). Severe alteration of the estuary environment and habitat degradation from logging in the 1950s and 1960s, compounded by the 1964 flood, are believed to be largely responsible for the depressed cutthroat trout population in Redwood Creek (Gerstung, 1997). This species is now under the jurisdiction of the USFWS and is undergoing a status review.

In the Redwood Creek Hydrologic Unit, six of six (100 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in 11 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. The high rate of occurrence and significant number of other streams known to support the species suggest that tailed frogs streams in the Redwood Hydrologic Unit are in good condition.

In the Redwood Creek Hydrologic Unit, five of six (83.3 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 61 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. The high rate of occurrence and large number of other streams known to support the species suggest that torrent salamander streams in the Redwood Creek Hydrologic Unit are in good condition.

3.4.4.6 Coastal Lagoons Hydrographic Region

Channel and Estuary Conditions

No channel or habitat typing assessments or LWD surveys have been conducted by Simpson in this HPA. Long-term channel monitoring is ongoing in two locations within the Coastal Lagoons Hydrographic Region - Maple Creek and Beach Creek. Monitoring began on both reaches in 1998. No conclusions can be drawn at this point from the monitoring.

Stone Lagoon is approximately 500 acres in size and is where salmonids from McDonald Creek generally rear to maturity. Because the lagoon only opens to the ocean occasionally, salmonids have limited opportunities to pass between the two water bodies. However, the brackish lagoon is highly productive and supports a diverse aquatic ecosystem.

Species Status

Specific information on anadromous salmonids in the Coastal Lagoons Hydrographic Region is limited. Population sizes are probably small and potentially non-existent in some years, as Big and Stone Lagoons are only open to the ocean for short time periods in winter and early spring, limiting the ability of anadromous fishes to migrate between the ocean and the lagoons.

The Coastal Lagoons Hydrographic Region is within the California Coastal chinook salmon ESU, which was listed as threatened under the federal ESA as of September 16, 1999 (64 FR 50394). This HPA is within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). The Coastal Lagoons Hydrographic Region is within the Northern California steelhead ESU, which was listed as threatened on June 4, 2000 (65 FR 36074). Coastal cutthroat are now under the jurisdiction of the USFWS and are undergoing a status review.

As many as 1,200 coho salmon and 3,000 steelhead may have occurred in Maple Creek, a tributary to Big Lagoon, as late as the 1960s (USFWS, 1967). Recent spawning surveys conducted by Simpson personnel during 1998 and 1999 have observed only a small number of redds, indicating limited spawning by salmonids in Maple, North Fork Maple, and Pitcher Creeks (see Appendix C-9 of the AHCP/CCAA). Big Lagoon is believed to support a “fair” population of coastal cutthroat trout (Gerstung, 1997). Simpson fisheries personnel observed high numbers of large coastal cutthroat in lower Maple Creek in 1999. Stone Lagoon had low numbers of cutthroat prior to heavy stocking of yearling fish in 1990 through 1994. Spawning escapement in McDonald Creek increased dramatically in the years following the stocking, but conditions in McDonald Creek are degraded and limit natural production (Gerstung, 1997).

Properties in the Coastal Lagoons Hydrographic Region were acquired by Simpson in 1998 after presence/absence surveys for tailed frogs had been completed. As a result, there is no estimate of the proportion of streams that support tailed frogs in this HPA. However, populations of tailed frogs have been confirmed in 22 streams throughout the HPA, either through other types of amphibian surveys by the prior landowner or incidental observations since the acquisition of the property by Simpson. Given the significant number of streams known to support the species, tailed frogs streams in the Coastal Lagoon Hydrographic Region are likely to be in good condition.

Populations of torrent salamanders have been confirmed in 47 streams throughout the HPA, either through other types of amphibian surveys by the prior landowner or incidental observations since the acquisition of the property by Simpson. Given the significant number of streams known to support the species, torrent salamander streams in the Coastal Lagoon Hydrographic Region are likely to be in good condition.

3.4.4.7 Little River Hydrologic Unit

Channel and Estuary Conditions

Channel and habitat typing assessments in the Little River Hydrologic Unit were conducted by Louisiana-Pacific Corporation fisheries personnel in 1994. Four streams were surveyed: the mainstem Little River, Upper and Lower South Fork Little River, and Railroad Creek (see Appendix C-1 of the AHCP/CCAA). Canopy density in the Little River Hydrologic Unit was high, ranging from 91 percent to 99 percent in the three streams surveyed. The species composition of the riparian canopy was predominantly deciduous on all streams. LWD was the dominant structural shelter component in pools and ranged from 17.3 percent to 38.5 percent. Partitioning of habitat into pools, riffles, and runs showed a high percentage of pools (45 percent to 56 percent) on all four streams surveyed.

Pool tailout embeddedness values were moderate, mainly in the 26 percent to 50 percent range. Pool depths were predominantly 3 feet or less on Railroad Creek and the South Fork Little River, while half of the mainstem Little River pool depths were greater than 3 feet. No long-term channel monitoring has been conducted by Simpson in this HPA.

An LWD inventory was conducted during 1994 and 1995 in the same four streams in which channel and habitat type assessments were conducted. The instream LWD piece counts per 100 feet of channel were relatively high for the watershed size in Railroad Creek, and the Upper and Lower South Fork Little River, ranging from 5.1 to 8.1 pieces per 100 feet. LWD in the mainstem Little River was also more numerous than other streams in the Primary Assessment Area with similar watershed sizes (see Appendix C-2 of the AHCP/CCAA).

The Little River estuary has been impacted to a certain degree by human activities. Livestock grazing has denuded some of the riparian zone along the lower channel, accelerating the erosion of streambanks. In spite of this, the Little River has more estuarine habitat than many local streams of its size, and surveys have indicated utilization of the estuary by juvenile chinook salmon (LP, 1986, CDFG, 1986). Although the Little River watershed is relatively small, its mouth rarely, if ever, bars over during the summer to form an enclosed lagoon.

Species Status

The Little River chinook population is depressed compared to historical estimates, but recent trends show a relatively stable population. Simpson personnel have observed small numbers of live adult and carcasses of spawned out chinook salmon, as well as redds, during spawning surveys conducted within the Little River during 1998 through 2000. Other tributaries to Little River (Upper South Fork and Lower South Fork Little River) had lower numbers of spawning chinook salmon observed during those surveys The Little River is considered one of the best local salmonid streams, with healthy genetic stocks, sufficient returns to seed the system, and good salmonid habitat (Weseloh and Farro, pers. comm.). The Little River Hydrologic Unit is within the California Coastal chinook salmon ESU, which was listed as threatened under the federal ESA as of September 16, 1999 (64 FR 50394).

The Little River coho population is depressed compared to historical estimates, but appears to be relatively stable over the last decade. Recent data indicates high numbers and densities of juvenile coho from the 1998-1999 brood year. Spawning surveys conducted by Simpson personnel have resulted in observations of live adults, and carcasses of spawned-out coho salmon, as well as coho redds, within Little River during 1998 through 2000, and the lower South Fork Little River from 1998 to 1999 (see Appendix C-9 of the AHCP/CCAA). Coho salmon dominated the out-migrant smolt estimates in the Lower South Fork Little River and Carson Creek in 2000, exceeding 1,600 and 1,800 smolts respectively (see Appendix C-8 of the AHCP/CCAA). As noted previously, the Little River is considered one of the best local salmonid streams, with healthy genetic stocks, sufficient returns to seed the system, and good salmonid habitat. This HPA is within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588).

The Little River Hydrologic Unit is within the Northern California ESU for steelhead, which was listed as threatened on June 7, 2000 (65 FR 36074). Steelhead abundance data are limited for this ESU, but available data indicate that winter-run populations declined significantly prior to 1970, and populations have remained at depressed levels with no clear trends since then (Busby et al., 1996). Specific information on steelhead populations in the Little River Hydrologic Unit indicates that the Little River has been and remains an excellent system for steelhead production, although current abundance is depressed compared to historical estimates. Outmigrant trapping in 1994 captured approximately 10,000 steelhead parr and 1,100 smolts (Shaw and Jackson, 1994). The ability of steelhead to use spawning and rearing habitat upstream of other salmonids in the Little River contributes to their success in this HPA (Weseloh and Farro, pers. comm.).

Coastal cutthroat trout are now under the jurisdiction of the USFWS and are undergoing a status review. Cutthroat trout populations in southern Oregon and northern California are thought to be widely distributed in many small populations, with the exception of the Rogue and Smith Rivers, which support large and healthy populations (Johnson et al., 1999). Specific information on coastal cutthroat trout populations in the Little River Hydrologic Unit are limited to recent estimates and observations; historical information for comparison is lacking. Outmigrant trapping in the mainstem Little River in 1994 captured 403 coastal cutthroat trout, ranging in size from 50 to 275 mm, with the bulk around 150 mm (Shaw and Jackson, 1994).

Properties in the Little River Hydrologic Unit were acquired by Simpson in 1998 after presence/absence surveys for tailed frogs had been completed. As a result, there is no estimate of the proportion of streams that support tailed frogs in this HPA. However, populations of tailed frogs have been confirmed in 15 streams throughout the HPA, either through other types of amphibian surveys by the prior landowner or incidental observations since the acquisition of the property by Simpson. Given the significant number of streams known to support the species, tailed frogs streams in the Little River Hydrologic Unit are likely to be in good condition.

Populations of torrent salamanders have been confirmed in 18 streams throughout the HPA, either through other types of amphibian surveys by the prior landowner or incidental observations since the acquisition of the property by Simpson. Given the significant number of streams known to support the species, torrent salamanders streams in the Little River Hydrologic Unit are likely to be in good condition.

3.4.4.8 Mad River Hydrographic Region

Channel and Estuary Conditions

Channel and habitat typing assessment was conducted in 1994/1995 in three streams in the Mad River Hydrographic Region: Lindsay Creek, Dry Creek, and Cañon Creek (see Appendix C-1 of the AHCP/CCAA). Lindsay Creek and Cañon Creek had average canopy closures of approximately 80 percent, while Dry Creek had a canopy closure of 92 percent. This canopy was composed of 75 percent to 85 percent deciduous trees. The percentage of LWD as shelter in pools ranged from 14 percent in Dry Creek to 27 percent in Lindsay Creek. Partitioning of habitat into pools, riffles, and runs showed a high (47 percent and 50 percent, respectively) percentage of pools in both Lindsay and Cañon Creeks, a feature indicative of good salmonid habitat. Dry Creek was predominantly (67 percent) riffles.

Pool tailout embeddedness was moderate in Cañon Creek and Dry Creek and high in Lindsay Creek, with 82 percent of the pools having embeddedness values of 50 percent or greater. Pool depths in Dry Creek were almost all less than 2 feet, while Canon and Lindsay

Creek pool depths were predominantly between 2 and 4 feet, with 17.6 and 15.6 percent of pools greater than 4 feet deep in Cañon Creek and Lindsay Creek, respectively.

Long-term channel monitoring is ongoing in one location within the Mad River Hydrographic Region. Monitoring began on the Cañon Creek in 1995. No conclusions can be drawn at this point from the monitoring.

There was a low level of both in-channel and recruitment zone LWD in Dry Creek and Cañon Creek, and a moderate level of LWD in Lindsay Creek (see Appendix C-2 of the AHCP/CCAA). The size of the inchannel LWD was predominantly small (less than 2 foot diameter), reflecting the alder-dominant riparian zones prevalent throughout the Primary Assessment Area. The LWD survey results may be misleading for Lindsay Creek, where most of the LWD is keyed into the banks, so that it is measured as small diameter and length, yet it affords the shelter and pool forming advantage of larger LWD. In Cañon Creek and Dry Creek, the lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote formation of pools. Stream health in the Mad River Hydrographic Region would benefit from increased abundance of large diameter and length LWD.

The Mad River estuary has been severely impacted by human settlement, beginning with the draining and diking of wetlands for agricultural use. The Arcata Bottoms (once the Mad River floodplain) has been extensively developed for livestock grazing and residential purposes. In addition, to prevent regular flooding of this area, a meander in the lower Mad River was cut off by excavation of a new channel segment in 1862. The lower channel was cleared of LWD jams to facilitate the transport of logs in the late 1800s. Since then, the unrestricted removal of logs by firewood cutters in the lower reaches has inhibited re-establishment of LWD in this area. Gravel extraction occurs at numerous locations below the Mad River Hatchery and has been an important commercial activity for some time, removing approximately 15.5 million cubic yards of gravel between 1952 and 1992. The Humboldt Bay Municipal Water District, which provides water to communities and industry around Humboldt Bay, pumps its water from wells in the lower Mad River, just above the Highway 299 Bridge. This history of development has resulted in channelization of the lower 10 miles of the Mad River.

Species Status

The Mad River Hydrographic Region is within the California Coastal chinook salmon ESU, which was listed as threatened under the ESA as of September 16, 1999 (64 FR 50394). Low abundance levels, sporadic occurrence in some river systems, and negative long term trends in abundance in this ESU were cited in the decision to list this ESU as threatened (September 16, 1999, 64 FR 50394). Nehlsen et al. (1991) identified Mad River fall-run chinook as at moderate risk of extinction. Abundance trends have declined in the Mad River Basin over the long term, but show signs of increasing in recent years (64 FR 50405). Spawning surveys have been conducted annually on Canon Creek from 1995 through 2000. Compared to other species, large numbers of chinook adults, redds, and carcasses have been observed during all years surveyed (see Appendix C-9 of the AHCP/CCAA).

Mad River Hatchery coho salmon stocks are not considered part of the SONCC coho salmon ESU, as they have included transplants from outside the area (Weitkamp et al., 1995). Coho salmon in the Mad River Hydrographic Region are within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon are fairly well-distributed within the lower portion of this HPA, but almost no information on total abundance or proportion of naturally spawning hatchery fish is available. Spawning surveys have been conducted annually on Canon Creek from 1995 through 2000. Very few coho adults, redds, and carcasses have been observed in any year (see Appendix C-9 of the AHCP/CCAA). Juvenile summer population estimates for coho salmon ranged from 43 to 919 juveniles during the 1995-2000 period (see Appendix C-7 of the AHCP/CCAA).

Summer steelhead abundance in the Mad River has been monitored from 1982 to the present, revealing unexpectedly high abundance in 1994 through 1996, with a sharp downward trend in more recent years (see Appendix C-10 of the AHCP/CCAA). Information on fall-run and winter-run steelhead is lacking. The genetic effects of the Mad River Hatchery steelhead releases on the native winter steelhead population is a source of concern in this HPA (Busby et al., 1996). The Mad River Hydrographic Region is within the Northern California steelhead ESU, which was listed as threatened on June 7, 2000 (65 FR 36074).

Cutthroat trout are only occasionally observed in the lower main stem Mad River, but are abundant in some lower Mad River tributaries, including Lindsay, Widow White, and Mill Creeks (Gerstung, 1997). Coastal cutthroat trout have not been observed above the confluence North Fork Mad River. This species is now under the jurisdiction of the USFWS and is undergoing a status review.

In the Mad River Hydrographic Region, 7 of 12 (58.3 percent) streams sampled as part of presence/absence surveys had tailed frogs, primarily in the lower portion of the drainage (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in 17 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations, only one observation was in the upper portion of the HPA. Given this moderate rate of occurrence and somewhat limited number of streams known to support the species, tailed frog streams in the Mad River Hydrographic Region appear to be in moderate condition. However, other tailed frog studies (e.g., headwaters monitoring and life history studies) in this HPA indicate that, depending on the localized geology, some streams provide excellent habitat for tailed frogs while others completely lack habitat for the species.

In the Mad River Hydrographic Region, 8 of 12 (66.7 percent) streams sampled as part of presence/absence survey had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 54 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given the moderate rate of occurrence, torrent salamander streams in the lower portion of the Mad River Hydrographic Region appear to be in relatively poor condition. However, other torrent salamander studies (e.g., headwaters monitoring and life history studies) and the relatively large number of streams known to support the species in this HPA indicate that, depending on the localized geology, some streams provide excellent habitat for torrent salamanders while others completely lack habitat for the species.

3.4.4.9 North Fork Mad River Hydrologic Unit

Channel and Estuary Conditions

Channel and habitat typing assessments were performed on two creeks within the North Fork Mad River Hydrologic Unit: North Fork Mad River and Long Prairie Creek (see Appendix C-1 of the AHCP/CCAA). Canopy density was 73 percent on the North Fork Mad River and 95 percent on Long Prairie Creek. Deciduous trees accounted for about 90 percent of the canopy on both creeks. LWD as structural shelter in pools was low in both creeks – 12.1 percent and 10.4 percent in the North Fork and Long Prairie Creek, respectively. Partitioning of habitat into pools, riffles, and runs showed a high percentage (47 percent) of riffles on Long Prairie Creek, and a high percentage (42 percent) of pools on the North Fork Mad River. The North Fork had 10 percent of its total length in dry channel.

Pool tailout embeddedness was high on the North Fork and low on Long Prairie Creek. Pool depths showed the opposite pattern. In the North Fork, over 50 percent of the pools were greater than 3 feet deep, while in Long Prairie Creek, less than 16 percent of the pools were greater than 3 feet deep. The differences in pool depth undoubtedly reflect the much larger size of the North Fork Mad River.

Long-term channel monitoring is ongoing at one location within the North Fork Mad River Hydrologic Unit. Monitoring began on the North Fork Mad River in 1997. An abbreviated version of the complete monitoring protocol is being used. No conclusions can be drawn at this point from the monitoring.

The North Fork Mad River had approximately one piece of in-channel LWD per 100 feet of channel, while Long Prairie Creek averaged 2.2 pieces per 100 feet. The size of the in-channel LWD present was predominantly small (less than 2 feet diameter), reflecting the alder-dominant riparian zones prevalent throughout the area (see Appendix C-2 of the AHCP/CCAA). The lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote formation of pools. Stream health in the North Fork Mad River Hydrologic Unit would benefit from increased abundance of large diameter and length LWD.

Species Status

Nehlsen et al. (1991) identified Mad River fall-run chinook salmon as at moderate risk of extinction. The North Fork Mad River Hydrologic Unit is within the California Coastal chinook salmon ESU, which was listed as threatened under the ESA as of September 16, 1999 (64 FR 50394). Abundance trends have declined in the Mad River Basin as a whole over the long term, but show signs of increasing in recent years (September 16, 1999, 64 FR 50394). A natural barrier to chinook and coho salmon migration occurs at roughly river mile (RM) 4 in the North Fork Mad River, severely limiting the spawning and rearing area available to chinook in this HPA. Spawner surveys in this HPA indicate highly variable returns of winter-run chinook to the North Fork Mad River and its tributaries below the barrier.

The North Fork Mad River Hydrologic Unit is within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). Spawner surveys and juvenile population estimates below the barrier also indicate low numbers of coho returns in this HPA (see Appendices C-7 and C-9 of the AHCP/CCAA).

Steelhead are able to pass the natural barrier mentioned previously for chinook and coho salmon and therefore can use more of the North Fork drainage than other anadromous salmonids. The genetic effects of the Mad River Hatchery steelhead releases on the native winter steelhead population are a source of concern in the Mad River Basin (Busby et al., 1996). The extent of hatchery fish spawning naturally in the North Fork Mad River HPA is unknown. The North Fork Mad River Hydrographic Unit is within the Northern California steelhead ESU, which was listed as threatened on June 7, 2000 (65 FR 36074).

Coastal cutthroat are now under the jurisdiction of the USFWS and are undergoing a status review. Little is known about coastal cutthroat trout in the North Fork Mad River Hydrologic Unit. The natural barrier to anadromy on the main stem North Fork Mad implies that cutthroat trout in most of this HPA (above the barrier) are resident fish.

In the North Fork Mad River Hydrologic Unit, six of seven (85.7 percent) streams sampled as part of presence/absence surveys had tailed frogs (Diller and Wallace, 1999). In addition, populations of tailed frogs were confirmed in 28 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and the large number of streams known to support the species, tailed frogs streams in the North Fork Mad River Hydrologic Unit seem to be in excellent condition.

In the North Fork Mad River Hydrologic Unit, six of seven (85.7 percent) streams sampled as part of presence/absence surveys had torrent salamanders (Diller and Wallace, 1996). In addition, populations of torrent salamanders were confirmed in 80 other streams throughout the HPA, either through other types of amphibian surveys or incidental observations. Given this high rate of occurrence and large number of streams known to support the species, torrent salamanders streams in the North Fork Mad River Hydrologic Unit seem to be in excellent condition.

3.4.4.10 Humboldt Bay Hydrographic Region

Channel and Estuary Conditions

Channel and habitat typing assessments were conducted on four streams within the Humboldt Bay Hydrographic Region in 1995. Salmon Creek was assessed by Simpson personnel and Ryan Creek and two unnamed tributaries to Ryan Creek were assessed by the California Conservation Corps (see Appendix C-1 of the AHCP/CCAA). Canopy closure was high on all four creeks, ranging from 88 percent in Salmon Creek to 94 percent in Ryan Creek. The riparian canopy was predominantly deciduous on Salmon Creek and Ryan Creek (83 and 68 percent). This variable was not recorded on the two tributaries to Ryan Creek. The percentage of LWD as shelter in pools was 27.5 percent in Salmon Creek, and 17, 40, and 49 percent, respectively, in the two tributaries to Ryan Creek and the Ryan Creek mainstem. These are some of the higher values in Primary Assessment Area streams.

Partitioning of habitat into pools, riffles, and runs showed a moderately high percentage (44 percent) of pools on Salmon Creek and a high percentage of pools on Ryan Creek and the two assessed tributaries (65, 81, and 61 percent, respectively).

Pool tailout embeddedness was very high in all four creeks, probably because of the dominant substrate materials in these creeks. Pool depths were mainly 1 to 3 feet, with 18 percent greater than 4 feet in Salmon Creek. The assessed creeks in the Humboldt Bay Hydrographic Region had a high level of canopy closure and LWD as shelter, but very fine substrate was predominant, leading to high embeddedness values, shallow pools, and low overall shelter ratings. Long-term channel monitoring is ongoing in one location within the Humboldt Bay Hydrographic Region. Monitoring began on Salmon Creek in 1996. No conclusions can be drawn at this point from the monitoring.

Generalizations about LWD in the Humboldt Bay Hydrographic Region are difficult to make as only one creek in the region was surveyed (see Appendix C-2 of the AHCP/CCAA). Salmon Creek had an average of 4.0 pieces of in-channel LWD per 100 feet, one of the highest densities among the streams surveyed. The size of the in-channel LWD was predominantly small (less than 2 ft diameter), reflecting the alder-dominant riparian zones prevalent throughout the area. The lack of large diameter LWD results in low levels of in-channel LWD available to function as shelter or to promote the formation of pools. Stream health in the Humboldt Bay Hydrographic Region would benefit from increased abundance of large diameter and length LWD.

The estuaries of Humboldt Bay's watersheds have been vastly altered over the past century. Residential and agricultural development associated with the early harvesting of timber from the slopes surrounding Humboldt Bay greatly impacted watershed estuaries. Extensive areas of highly productive wetlands were converted to pasture and residential land through a complex series of dikes, tide gates, and levees. The lower section of Salmon Creek was channelized to maximize the amount of available pasture land. The tide gate on Salmon Creek has been suspected as being impassable by adult and juvenile salmonids on a wide range of flows. Recently, a section of the lower channel (now a National Wildlife Refuge) was reconstructed to its natural meander and the tide gate was modified to improve fish passage.

Species Status

The Humboldt Bay Hydrographic Region is within the California Coastal chinook salmon ESU, which was listed as threatened under the ESA as of September 16, 1999 (64 FR 50394). Drainages within the Humboldt Bay Hydrographic Region are typically small, with no large rivers, which are typically preferred by chinook salmon. Chinook populations within this HPA are thought to be low, and while historical estimates are not available for comparison, the small size of the Humboldt Bay drainages makes it unlikely that this HPA was ever a significant producer of chinook salmon.

The Humboldt Bay Hydrographic Region is within the SONCC coho salmon ESU, which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon have been documented in almost all of the drainages feeding Humboldt Bay. Information on coho abundance in these creeks is limited, but as with the ESU as a whole, current numbers are almost certainly depressed relative to historical estimates (Weitkamp et al., 1995).

The Humboldt Bay Hydrographic Region is within the Northern California ESU for steelhead, which was listed as threatened on June 7, 2000 (65 FR 36074). Steelhead abundance data are limited for this ESU, but available data indicate that winter-run populations declined significantly prior to 1970, and populations have remained at depressed levels with no clear trends since then (Busby et al., 1996).

Coastal cutthroat trout are now under the jurisdiction of the USFWS and are undergoing a status review. Gerstung (1997) reports that low numbers of coastal cutthroat have been reported in most tributaries where other salmonids are present, while much higher numbers have been observed in tributaries or headwaters of tributaries where no other salmonids are present. Current populations are thought to be depressed relative to historic levels (Gerstung, 1997).

In the Humboldt Bay Hydrographic Region, only two streams were sampled as part of presence/absence surveys and tailed frogs were found in one of them (Diller and Wallace, 1999). In addition, tailed frogs have only been found in 3 other streams throughout the HPA as the result of incidental observations. However, much of this HPA is located within young unconsolidated geologic formations, which have been shown to have a strong negative influence on tailed frog occurrence as a result of a lack of suitable stream substrate in these geologic formations (Diller and Wallace, 1999). Most streams in the Humboldt Bay Hydrographic Region are likely not suitable for tailed frogs and have no potential to become suitable outside of a geologic timeframe.

In the Humboldt Bay Hydrographic Region, only three streams were sampled as part of presence/absence surveys and no torrent salamanders were found in any of them (Diller and Wallace, 1996). In addition, torrent salamanders have only been found in three other streams throughout the HPA as the result of incidental observations. However, as noted above for tailed frogs, much of this HPA is located within young unconsolidated geologic formations. These formations have been shown to have a strong negative influence on torrent salamander occurrence due to a lack of suitable stream substrate in these geologic formations (Diller and Wallace, 1996).

3.4.4.11 Eel River Hydrographic Region

Channel and Estuary Conditions

Channel and habitat typing assessments have not been conducted by Simpson personnel within the Eel River Hydrographic Region. The CDFG has conducted channel and habitat typing assessments on four streams within the Eel River Hydrographic Region. Wilson Creek and Stevens Creek were both assessed in 1991, and Howe Creek and West Fork Howe Creek were assessed in 1998 (see Appendix C-1 of the AHCP/CCAA).

Canopy closure was moderate in the four creeks surveyed, ranging from 57 percent in Howe Creek to 86 percent in West Fork Howe Creek. The existing canopy was mainly deciduous in all four creeks (71 to 95 percent deciduous). The percentage of LWD as the dominant structural shelter component in pools varied widely within the Eel River Hydrographic Region from zero percent in West Fork Howe Creek to a high of 48 percent in Stevens Creek. The average value for the four creeks was 15.5 percent.

Partitioning the streams into pools, riffles, and runs showed a high percentage of riffles on Wilson Creek (86 percent), Howe Creek (65 percent), and West Fork Howe Creek (74 percent). Only Stevens Creek had more than 10 percent of its total length composed of pool habitat (26 percent pools).

Howe, West Fork Howe, and Wilson Creeks all had high pool tailout embeddedness values as well as mainly shallow (less than 2 feet) pools. Stevens Creek had low pool tailout embeddedness and 57 percent of its pools were greater than 2 feet in depth. Stevens Creek contains significantly better salmonid habitat than the other three creeks assessed in the Eel River Hydrographic Region.

Simpson has not conducted any LWD inventories within the Eel River Hydrographic Region, and no long-term channel monitoring reaches have been established in the Eel River Hydrographic Region.

The lower Eel River has lost valuable fisheries habitat through human activities. Wetlands, secondary channels, and sloughs have been impacted through extensive diking and channelization. The original floodplain is now used for residential and agricultural purposes, mainly grazing of dairy cattle. Sediment deposits transported from upstream areas have turned once deep pools into shallow runs, which offer marginal habitat for juvenile salmonids. The lower channel was also cleared of LWD jams for navigational purposes.

Species Status

Peak index counts and carcass surveys for chinook salmon in two tributaries to the Eel River have shown precipitous long-term declines since the 1960s, with recent increases in one tributary. Similar monitoring for chinook salmon in other tributaries conducted since the late 1980s have also shown steep declines. Spring-run chinook salmon in the upper Eel River are possibly extinct, representing a significant loss of life history diversity in this ESU as a whole (64 FR 50405). The Eel River Hydrographic Region is within the California Coastal chinook salmon ESU, which was listed as threatened under the ESA as of September 16, 1999 (64 FR 50394).

The Eel River Hydrographic Region is within the SONCC coho salmon ESU which was listed as threatened on May 6, 1997 (62 FR 24588). Coho salmon abundance in the Eel River, as within the rest of the SONCC coho ESU, is depressed (Weitkamp et al., 1995). The abundance of introduced Sacramento pike minnow in the Eel River is a cause for concern.

Nehlsen et al. (1991) identified summer steelhead in the Eel River as at risk of extinction, although the Little Van Duzen River winter steelhead stock was identified as stable in further analysis by Higgins et al. (1992). Counts at Eel River dams in the 1930s and 1940s averaged 4,400 adult steelhead annually at Cape Horn Dam and 19,000 adult steelhead annually at the Benbow Dam. Recent counts at Cape Horn Dam average 115 adults, of which only 30 are native fish. In addition to these declining trends, the abundance of the introduced Sacramento pike minnow and sedimentation are some of the main concerns cited for steelhead in the Eel River (Busby et al., 1996). The Eel River Hydrographic Region is within the Northern California ESU for steelhead, which was listed as threatened on June 7, 2000 (65 FR 36074).

Coastal cutthroat trout are now under the jurisdiction of the USFWS and are undergoing a status review. Cutthroat trout are found in one tributary to the lower Eel (Strongs Creek), one tributary to the Van Duzen (Fox Creek), and a few small streams which flow into the Salt River Slough (Gerstung, 1997). No Primary Assessment Area lands exist in the drainages of these tributaries.

In the Eel River Hydrographic Region, only two streams were sampled as part of presence/absence surveys and no tailed frogs were found in either of them (Diller and Wallace, 1999). In addition, no tailed frogs have been found in other streams throughout the HPA as the result of incidental observations. However, much of this HPA is located within young unconsolidated geologic formations, which have been shown to have a strong negative influence on tailed frog occurrence due to a lack of suitable stream substrate in these geologic formations (Diller and Wallace, 1999). Most streams in the Eel River Hydrographic Region are likely not suitable for tailed frogs and have no potential to become suitable outside a geologic timeframe.

In the Eel River Hydrographic Region, only one stream was sampled as part of presence/absence surveys and no torrent salamanders were found (Diller and Wallace, 1996). In addition, no torrent salamanders have been found in other streams throughout the HPA as the result of incidental observations. However, as described above for tailed frogs, much of this HPA is located within young unconsolidated geologic formations. These formations have been shown to have a strong negative influence on torrent salamander occurrence as a result of a lack of suitable stream substrate in these geologic formations (Diller and Wallace, 1996).

3.4.4.13 Rain-on-Snow Areas

The rain-on-snow areas are generally located at elevations above 2,500 feet. Channel and habitat typing assessments have not been conducted in the three rain-on-snow units outside of the 11 HPAs, with the exception of one survey on Elk Creek within the northernmost block. Consequently there is limited information on channel and habitat conditions within these areas.

Simpson has conducted surveys of anadromous salmonids within the three rain-on-snow units. The Elk Creek system within the northernmost block (Moore Tract) contains all four salmonids (coho, chinook, steelhead, and cutthroat trout). The lower portions of tributaries that extend into the Simpson ownership in the South Fork Trinity River basin (University Hill Tract) have limited anadromy access, mostly steelhead. Chinook and coho are to be found mostly downstream of the Simpson ownership within this same watershed area. It is unknown if salmonids occur within the Supply Creek Tract, although it is known that they are distributed downstream of this third ownership block.

Simpson has conducted studies of tailed frogs and southern torrent salamanders to determine their distribution, relative abundance and habitat associations throughout the ownership. These amphibian species have been found at several sites in the rain-on-snow areas.

Little information is available about presence and distribution of the other fish, amphibian, and reptile species covered under Alternative C in the rain-on-snow areas.

3.4.5 Ecological Implications of Land Management Activities on Aquatic and Riparian Habitat, Fish, and Amphibians

3.4.5.1 Background

Understanding the ecological implications of planned land use activities and management commitments on aquatic ecosystems provides a basis for analyzing potential effects of the Proposed Action, other action alternatives, and the No Action Alternative. All land use practices within the Primary Assessment Area and the additional 26,116 rain-on-snow acres under Alternative C could affect aquatic ecosystems to varying degrees. Depending on how land use practices are implemented, their effects could be either adverse or beneficial. Ecological implications and cause-effect relationships associated with past and current land use practices provide a basis for understanding the existing environment and for predicting effects on species and habitat conditions under the alternatives.

These cause-effect relationships generally are well documented in the literature and are considered by most biologists to be relatively common scientific knowledge. The ecological implications and cause-effect relationships are therefore summarized in the following text. A detailed discussion of the potential effects of timber management on covered species and their habitats is also contained in Appendix E of the AHCP/CCAA. Most of the cause-effect relationships apply directly to fish, especially salmonids, and their habitat. However, because the amphibian and reptile species being addressed in this document also depend on functioning aquatic habitat and cool, clean water, the cause-effect relationships described below are applicable to all species covered under the Proposed Action and other alternatives.

3.4.5.2 Historical Management of Aquatic and Riparian Habitat

Prior to 1950, forest harvesting and other timber-related uses along streams and rivers differed little from upslope harvesting: forests were used from the ridge to the stream's edge (Gregory, 1997). Some practices, such as dragging logs and using splash dams to create artificial floods, directly or indirectly delivered sediment to streams, lakes, and estuaries; removed forest canopies and warmed water temperatures; altered forest habitats and reduced future sources of wood inputs; and simplified and narrowed floodplains. On federal land, production of timber commodities was the primary goal prior to the Multiple Use-Sustained Yield Act of 1960, the National Wilderness Act, and the Wild and Scenic Rivers Act. Prior to 1960, riparian management was not consistently practiced across federal lands, and no particular protection was identified for riparian areas. Mining for gold and coal on timbered lands also significantly altered rivers and floodplains (Oliver et al., 1994). In addition, there was little or no attempt to restrict grazing in the open range or the effects of water-based recreation.

Prior to the 1930s, grazing and timber harvesting became regulated where public concern for preventing siltation into irrigation reservoirs was raised. Stream channels were straightened to prevent stream bank erosion and control floods (Oliver et al., 1994). For years, standard forest practice was to remove structures from stream channels to improve conveyance. One result of controlled flooding was that roads increasingly encroached on channels and floodplains, often constricting the channel's ability to interact with the floodplains (McIntosh et al., 1994). After 1950, the public and resource managers increasingly expressed concerns over effects of land uses on streams and anadromous salmonids.

There is wide agreement that historical land use practices prior to 1973 adversely affected the structure and productivity of aquatic ecosystems (Elmore and Beschta, 1987; MBTSG, 1998). In 1973, however, passage of the Z'Berg-Nejedly Forest Practices Act by the State Legislature created a framework and multi-disciplinary review process to ensure consideration of riparian and aquatic resource values in the development of timber harvesting plans on state and private lands. The state Board of Forestry, created by the Act, has responsibility for development of forest practice rules (CFPRs), as necessary and appropriate, to protect riparian and aquatic resources. The CFPRs are administered by the California Department of Forestry and Fire Protection. Pertinent examples of CFPRs relevant to fish and wildlife habitat management include: (1) watercourse and lake protection zone rules; (2) special rules to protect fish, wildlife, and watersheds; and (3) rules for defined special treatment areas. (See Section 1.2.2, *State Requirements*.)

3.4.5.3 Forested Landscapes: Functions and Disturbances

Ecological Functions

The aquatic habitat of greatest interest in the Primary Assessment Area and the additional 26,116 rain-on-snow acres under Alternative C is that which supports, or could potentially support, the eight fish, four amphibian, and one reptile species described above and covered under the various action alternatives. Habitat conditions and requirements important to the survival of these species are numerous, but primarily can be summarized in terms of water quality and the quality and quantity of physical stream habitat available.

Water quality encompasses many attributes, but principally refers to sediment loads and sedimentation within a stream, water temperature and dissolved oxygen levels, and concentrations of nutrients and pollutants. Sedimentation is important because, if it is high, it can embed and reduce the amount of interstitial spaces within the stream substrate. This, in turn, has the potential to limit the production of aquatic insects (food source), suitable spawning areas, and cover areas for fry (salmonids) and larvae (amphibians). Temperature is important because the covered species prefer cool-water conditions and cannot tolerate elevated water temperatures, particularly for extended periods. Nutrients are important in food production, although extreme levels can have some of the same adverse effects on aquatic organisms as pollutants.

Habitat quality (and quantity) primarily refers to the complexity of the stream system and stream flow. Habitat complexity is defined by the type and amount of spawning, rearing, foraging, resting, and overwintering habitat, as well as habitat available for protection from predators. Flows often strongly influence the quantity of habitat available diurnally, seasonally, and among years, and dictate the magnitude and effects of extreme events such as high-flow (scouring) and low-flow (drought) conditions.

Riparian (and potentially upland) areas of forest ecosystems greatly influence both the water and physical habitat attributes of streams and rivers. The degree of influence, whether negative or positive, is generally related to the amount and type of vegetation present and the amount of disturbance from land management activities that occurs. Vegetation functions to provide LWD to the stream, canopy closure, bank stabilization, sediment trapping, nutrient inputs (leaf litter and dissolved materials), microclimate, and flow regime modifications. Riparian areas also can act as buffers that prevent or attenuate stream inputs of management-related materials like fine sediment or chemicals applied during forest management. More specific details on these functions are provided in the following sections.

Landscape Disturbances

Ecological functions and processes of forest stands vary as species composition and stand structure change during successional development. Disturbances that alter or interfere with these successional changes have the potential to degrade, reset, or redirect the trend of their ecological functions. Current forested landscapes reflect the effects of climate, topography, and past ecological disturbances.

The primary natural disturbances affecting plant communities are fire, grazing and browsing by ungulates, insect outbreaks and disease epidemics, windthrow, flooding, and erosion (hillslope mass wasting and surface erosion). Most of these processes are altered by human activities. Disturbance, interacting with climate and topography, produces landscape heterogeneity.

Natural and human disturbances have long-term influences on the appearance and composition of forests and the ecological services they provide (Waring and Schlesinger, 1985). Natural disturbance regimes generally provide beneficial ranges of ecological responses, and are required to create and maintain sustainable ecosystems and associated habitats and ecological processes (Everett et al., 1994; Johnson et al., 1994). The historical or natural range of variability is useful for establishing the limits of acceptable change for ecosystem components and processes (Morgan et al., 1994).

Disturbances that do not emulate historical events and disturbance scales, or replace elements required by the ecosystem, can be destructive (Everett et al., 1994). Disturbances caused by timber harvesting can be qualitatively and quantitatively different from natural disturbances; for example, there is no natural analog to disturbances created from road building. Compared to riparian areas with sustained commercial timber harvesting, disturbance patterns in no-cut riparian buffers are more likely to approximate the temporal patterns of natural processes. Repeated harvest activities shift the timing of disturbances from episodic (pulse) events to chronic (press) events.

3.4.5.4 Land Management Activities and Ecological Implications

The following land management activities are commonly associated with timberlands. These activities can potentially impact aquatic habitat, and have been identified in Biological Opinions on federal land management actions for several listed native salmonids. The activities are silviculture and forest management; road construction, reconstruction, and maintenance; fire management; and recreation and fishing. Because roads are an integral part of forest management activities, the effects of road construction, reconstruction, and maintenance are discussed along with the effects of forest management. Effects of fire management and recreational activities that may affect the quantity and quality of aquatic habitat are discussed briefly following the discussion of forest management.

Spence et al. (1996) described the effects of human activities on watershed processes, salmonids, and their habitats. Chamberlain et al. (1991) summarized four effects of forest management that may modify the hydrologic and geomorphic processes and channel formations that determine the quantity and quality of salmonid habitat. They are:

- Alterations in the hydrologic cycle with potential increases in peak flows or occurrences of channel-forming flows from increased snow-melt or runoff, resulting in increased bed scour and bank erosion
- Increases in sediment supplies from surface erosion, hillslope mass wasting, and bank erosion, leading to channel aggradation, loss of pool volume, and degradation of spawning gravels
- Destabilization of streambanks due to removal of riparian vegetation, physical breakdown, or channel aggradation, resulting in increased sediment supplies and leading to a loss of channel formations that promote a diversity of habitat types

- Loss or reduction of LWD by direct removal, debris torrents, or management practices that convert riparian corridors to younger stands of predominantly hardwoods, contributing to reduced sediment storage sites, and reduced pool numbers and volumes

There has been less research on the potential effects of timber harvesting on amphibian species, but most of the potential effects on salmonids and their habitat are believed to also affect the cool-water adapted stream amphibians. In general, timber harvesting activities have the potential to affect aquatic species (i.e., fish and amphibians) through alteration of one or all of the following processes: hydrologic cycle, sediment inputs and transport, LWD recruitment and distribution, thermal regimes, and nutrient inputs. These and related issues are discussed below under the following headings: effects on the hydrologic cycle, effects on erosion and sedimentation, effects on water quality, and effects on physical habitat.

Effects of Forest Management on the Hydrologic Cycle

The basic components of the hydrologic cycle are precipitation, infiltration, evaporation, transpiration, storage, and runoff. In the coastal areas of northern California, where annual precipitation is highly seasonal, the timing, quantity, and quality of rain and snow fall has great influence on salmonid life histories. Thus, the interactions of timber harvest activities with the hydrologic cycle are important.

Snow Accumulation and Melt. Coastal watersheds of northern California receive most of their precipitation as rain. However, some watersheds in the Primary Assessment Area have upper sections within the transition zone between rain and snow. Along hillslopes in these upper watersheds, the forest canopy intercepts snowfall, redistributes the snow, shades the snowpack, and acts as a windbreak. In these transient areas the snow is generally wet and sticks to the forest canopy longer than colder, drier snow. In transitional areas, snow usually reaches the ground in clumps under trees or as snow melt so that snow pack in forested areas tends to vary in distribution and depth compared to logged hillslopes (Berris and Harr, 1987).

Snow melt from hillslopes in coastal watersheds is usually the result of warmer rainfall or latent heat in air moisture rather than from solar radiation. Snow packs in transitional areas may accumulate and melt several times during the wet season. When the forest canopy has been removed, more of the snow pack is directly exposed to rainfall, warm air, and direct sunlight. Harr (1986) reported there was more heat available to melt snow in a clear-cut stand than in an old-growth Douglas-fir stand during a rain storm with a 2-year recurrence interval. Plot studies in paired watersheds (logged and unlogged) have shown increases in peak streamflow after rain-on-snow events in the logged areas (Harr and McCorison, 1979; Christner and Harr, 1982).

Evapotranspiration and Infiltration. The timber management activities of clearcutting, shelterwood cutting, and precommercial thinning all reduce or eliminate significant amounts of leaves and stems. The surface area of this vegetation normally intercepts precipitation for short-term storage that is either evaporated or released as drip. The loss of forest vegetation also reduces the amount of water extracted from the soil by root systems via evapotranspiration and increases soil moisture and piezometric head. These effects have been demonstrated following harvest of second growth redwood forest (Keppeler and Brown, 1998). These factors may lead to increases in soil water content and in surface runoff. Some studies have reported increases in water yield from logged watersheds (Hibbert, 1967;

Harr et al., 1979). These increases were most evident in the start of the fall / winter wet season when rain quickly filled soil pore spaces in the logged areas and then ran off as surface flow (Harr et al., 1979). Differences were less apparent later in the rainy season since soil under mature canopies also becomes saturated, and runoff from logged and unlogged areas became nearly similar (Hibbert, 1967; Harr et al., 1979).

Soil Structure. The soil structure of forested hillslopes regulates the downslope movement of water through the soils and into watersheds. On forested hillslopes the infiltration capacity of the soils usually exceeds rainfall or snowmelt intensities so that all water is absorbed by these soils and transported to stream channels through subsurface pathways (Dyrness, 1969; Harr, 1977). Timber harvest activities that disturb the soil can reduce the infiltration capacity of soils and alter the process of subsurface water movement.

When logging activities compact or disturb surface soils the infiltration capacity is reduced, possibly increasing surface runoff, peak stream flows, and sediment inputs. The compacted surfaces of logging roads and landings are impermeable and water runs off them quickly. Inboard ditches along logging roads not only collect and concentrate surface runoff, but also intercept subsurface flow and bring it to the surface (Furniss et al., 1991). Some studies have shown that forest roads increase peak flows and sediment inputs to small watersheds when as little as 2.5 to 3.9 percent of the watershed is composed of road surfaces (Harr et al., 1975; Cederholm et al., 1981; King and Tennyson, 1984). Conversely, other studies have shown that road construction and some logging activities may have no significant effect on storm runoff (Wright et al., 1990; Johnson and Beschta, 1980).

Effects of Forest Management on Erosion and Sedimentation

Sedimentation is the end result of the erosion of soils in upland and riparian areas that are transported to streams. Erosion is the detachment and movement of soil or rock by water, wind, ice, or gravity (Brady, 1974). Hillslope erosion, sediment delivery, and sediment transport are all naturally occurring processes. The amount and rate of sediment introduced to watersheds is a function of many parameters, including the geology of hillslopes, dominant soil types, climatic conditions, and the occurrence of catastrophic events (floods, fires, earthquakes, or volcanic eruptions).

Timber harvesting and other land use activities can influence upslope erosional processes and how watersheds process sediments. It is important to realize that erosion and sediment transport are “normal” processes and that stream channels are dynamic systems that are constantly changing and adjusting to a variety of inputs. However, timber management activities and road construction, reconstruction, and maintenance, plus exposed soils in the road prism, can accelerate erosion and increase the potential for sediment delivery to streams. The following sections describe the potential impacts that forest management activities, particularly associated with roads, may have on sediment deposition and sediment processing in a watershed.

Sediment Deposition. Eroded materials delivered to streams and deposited on the streambed affect aquatic habitat. The construction, maintenance, and use of forest roads have been indicated as primary sources of sediment impacts in managed watersheds (USFWS, 1998a; Packer, 1967). Increased levels of fine sediment in streambed gravels have been associated with decreased salmonid embryo survival (Cederholm et al., 1981; Tappel and Bjornn, 1983) and the quality of juvenile rearing habitat (Bjornn et al., 1977). Fine sediment fills the interstitial spaces among gravels and, if severe, can suffocate incubating fish eggs by blocking the flow of water and oxygen to the eggs. Juvenile fish, particularly newly hatched individuals, use interstitial spaces as refugia from high water velocities and predators (Rieman and McIntyre, 1993). Land management that minimizes erosion and sediment delivery to streams addresses this well-documented sensitivity (Chapman, 1988).

Two erosional processes, surface erosion and hillslope mass wasting (landslides and debris flows), are of principal importance on forest hillslopes (Swanston, 1991). Surface erosion in forested watersheds occurs principally through the action of water on the soil surface. Hillslope mass wasting occurs when the force of gravity exceeds the resistive forces that hold the soil on the hillslope, causing mass movement of the soil as a unit. Hillslope mass wasting usually occurs when water accumulates on steep slopes.

Surface Erosion. A common source of sediment input to watersheds is surface erosion. Surface erosion can be a major contributor of sediment in areas where soils are composed of granite or highly fractured marine sedimentary rocks (Furniss et al., 1991). Surface erosion is a two-part process in which particles are first detached and then transported downslope. The two hydrologic processes that transport surface erosion are channelized erosion by constricted flows (rilling and gullying) and sheet erosion in which soil movement is non-channelized (rolling and sliding) (Swanston, 1991). Surface erosion by rainsplash and sheetwash processes from roads (including cut slopes), stream crossings, landings, skid trails, and ditches may all contribute to substantial increases in surface erosion and increased delivery of sediments into stream channels (Reid and Dunne, 1984; Luce and Black, 1999).

Surface erosion occurs on nearly all roads, but the timing and volume of sediment delivery to streams varies with the location and design of the road, ditches, and stream crossings. The delivery rate of road-related sediment to streams is highest where (1) ditches or culverts drain directly to streams, and (2) the distance between the stream and nearby road is insufficient to filter the sediment-laden water (Ketcheson and Megahan, 1996; Megahan and Ketcheson, 1996). Erosion may also occur in association with culvert failures and diversions because of culvert blockages (Piehl et al., 1988; Furniss et al., 1991). Road erosion rates are highest during the first one or two years following road construction, then normally decrease to less than half as much in successive years (Megahan, 1974; WFPB, 1995). Irrespective of their age, roads that receive heavy traffic produce substantially more sediment than low-use or closed roads (Reid and Dunne, 1984; Bilby et al., 1989).

In the past 25 years, studies and reports have shown that road construction for timber harvesting can increase erosion rates within a watershed (Haupt, 1959; Gibbons and Salo, 1973; Beschta, 1978; Cederholm et al., 1981; Reid and Dunne, 1984; Swanson et al., 1987; Furniss et al., 1991). Roads affect watersheds by modifying natural drainage patterns and by accelerating erosion and sedimentation, thereby altering channel stability and morphology. If proper construction techniques and maintenance practices are not followed, sediment increases following road construction can be severe and long-lasting. Gibbons and Salo (1973) concluded that the sediment contribution per unit area from forest roads is usually greater than that contributed from all other timber harvesting activities combined. Recently, techniques have been developed to improve the construction and maintenance of forest roads that minimize erosion and sedimentation (Weaver and Hagans, 1994).

Yarding and skidding activities can also affect the rate of surface erosion. Heavy equipment compacts soils, decreasing infiltration and percolation rates and increasing surface water (Lewis, 1998). The pattern of yarding and skidding can alter drainage paths and redirect water onto areas that may be more likely to erode than naturally evolved channels. Where vegetation and duff are removed, the underlying soils become vulnerable to surface erosion. Burning can also increase erodibility by creating bare ground. The effect of burning on surface erosion depends primarily on the temperature of the burn, soil cover, and soil and vegetation types (Lewis, 1998).

Hillslope Mass Wasting. In steep mountainous terrane, hillslope mass wasting is a major type of hillslope erosion and sediment source in watersheds (Sidle et al., 1985; Swanston, 1991). The frequency and magnitude of hillslope mass wasting is governed by hillslope gradient, level of soil saturation, composition of dominant soil and rock types, degree of weathering, type and level of management activities, and occurrence of climatic or geologic events. Hillslope mass wasting movements are usually episodic events and tend to contribute significant quantities of sediment and organic debris to stream channels over time intervals ranging from minutes to decades (Swanston, 1991). The resultant sediment and organic debris may have a profound effect on a stream channel including large increases in coarse and fine sediments, shifts of existing bed-load, and increases in woody debris that can lead to partial or complete blockages. In extreme situations, debris torrents may scour the existing bed-load of hundreds of meters of stream channel down to bedrock.

Hillslope mass wasting is a naturally occurring watershed process that can be accelerated by human activities. The occurrence of hillslope mass wasting after logging is closely linked to the type and intensity of harvest practices (Rood, 1984; Swanson, 1987). Hillslope mass wasting on logged hillslopes generally result from soil disturbances, increased water content in soils, and decreased root strength of decaying stumps. Numerous studies have reported increases of hillslope mass wasting due to clearcutting ranging from two to 31 times original rates, with an average of 6.6 (Rood, 1984; Ice, 1985; Howes, 1987; Swanson et al., 1987).

Forest road systems and their associated stream crossings in steep coastal watersheds are a major cause of hillslope mass wasting. Cederholm et al. (1981) reported that in Washington’s Clearwater watershed, 60 percent of road related sediment production was from associated hillslope failures and that road surfaces accounted for 18 percent to 26 percent of the sediment production. Roads can lead to increases in the frequency and severity of all types of hillslope mass wasting. Studies in the western Cascades of Oregon by Sidle et al. (1985) reported that hillslope mass wasting associated with forest roads occurred 30 to more than 300 times more often than in undisturbed watersheds. Increases in hillslope failures due to roads are affected by variables such as hillslope gradient, soil type, soil saturation, bedrock type and structure, management levels, and road placement. However, the literature suggests that road placement is the single most important factor because it affects how much the other variables will contribute to slope failures (Anderson, 1971; Larse, 1971; Swanston, 1971; Swanston and Swanson, 1976; Weaver and Hagans, 1994).

Techniques are available to identify hillslopes susceptible to hillslope mass wasting by the use of aerial photography and engineering analysis (Swanson et al., 1987). These measures may be useful in identifying areas where management activities should be avoided or at least conducted in a manner to minimize soil disturbance. Once mass movements have occurred, measures to correct erosion are expensive, time consuming, and rarely successful (Chamberlain et al., 1991).

Sediment Processing. Sediment processing in watersheds consists of the detachment and entrainment of sediment particles by flowing water, sediment transport, and sediment deposition. Once sediment has been delivered to the stream channel its movement through the watershed is governed by numerous factors. These include particle size and shape, amounts of sediment, hydraulic characteristics (frequency and magnitude of elevated flows, size of watershed, and channel gradient), and the occurrence of structures that provide complexity and roughness to channels (boulders, LWD, bedrock, or riparian vegetation).

Sediment is transported as either suspended sediment or as bedload. Suspended sediment consists of fine particles (less than 0.1 mm in diameter) that are entrained in the water column by the turbulence of flowing water. Suspended particles may be transported during a wide range of stream flows. Bedload transport occurs during storms when elevated stream discharge disrupts the armouring layer of the bed, which causes the bed material (particles greater than 1.0 mm in diameter) to roll, slide, or saltate downstream. The downstream transport of bedload is dependent on the magnitude of the stream discharge, channel gradient, and size of bedload particles (Leopold et al., 1964). The flows that initiate transport and sorting of bed material are often referred to as "channel forming flows," have a recurrence interval of approximately 2 to 3 years, and also are the flows responsible for changes in channel morphology.

Timber harvest activities affect sediment processing by increasing sediment supplies, altering the timing and frequency of peak flows, and by changing the channel structure through the reductions of important sediment storage sites provided by LWD (Chamberlain et al., 1991). Additional erosion may occur when stream banks are destabilized and the channel moves laterally and scours bank material (Scrivener, 1988).

Increased sediment delivery to stream channels affects bedload transport mechanisms, channel formations, and aquatic habitats. Increases in bedload can result in increased storage of sediment, which may lead to decreases in the number and depth of pools, a widening of the channel, and destabilization of stream banks (Everest et al., 1987). The effects of increased sediment can be short lived or persistent, depending on the amount and duration of the sediment source. Using a bedload and transport and routing model, O'Conner and PWA (2001) reported that a period of decades is required for gravel size material to be transported from the upper Freshwater Creek watershed to the lower watershed. Sand-size material is probably routed from source areas to lower Freshwater Creek over a period of about a decade. Hartman et al. (1987) reported that on Carnation Creek sudden pulses of fine sediment tended to be processed within several years, provided the watershed was not overloaded with sediment and that the erosional sources were healed. However, a channel subjected to continuous and persistent increases of sediment may become braided at low flows with much discharge occurring as sub-surface flow, and as a wide shallow channel at high flows that has a reduced capacity to transport elevated discharges. Continuous inputs of fine sediments also may infiltrate deeply into the channel bed and can persist for many years (Swanston, 1991).

Effects of Forest Management on Water Quality

Primarily, four aspects of water quality can be affected by forest management activities:

- Sedimentation
- Water temperature
- Dissolved oxygen levels
- Contaminant levels

Sedimentation. The amount of sediment deposition in a stream depends on the availability of sediment through erosion, and the rate of sediment delivery to the stream. Generally, the amount of sediment created from timber management activities is related to the amount of bare and compacted soils that are exposed to rainfall and runoff. Slope steepness, slope storage capacity, and proximity to stream channels determine the rate of sediment delivery (Quigley and Arbelbide, 1997). Activities such as skidding and yarding can compact soils because of the machinery used, especially at landings. Skidding generally causes more ground disturbance than cable or helicopter yarding. However, cable yarding on steep slopes also may result in soil disturbances because the ends of trees may drag on the ground, scarring and exposing soil.

Logging activities of timber harvesting, site preparation, and road construction may increase the amount of suspended sediment within a watershed. The amounts vary seasonally, but logging activities can alter the amount, timing, and duration of suspended sediments. Most studies have shown that roads are the main sources of suspended sediment associated with timber management activities (Anderson, 1971; Cederholm et al., 1981; Furniss et al., 1991; Swanston, 1991). The effect of roads on sediment inputs were described above.

Laboratory studies have revealed the negative effects of suspended sediment on developing salmonid eggs and embryos, yet results from field experiments have been less conclusive (Everest et al., 1987). Newcombe and MacDonald (1991) provided an extensive review of more than 70 studies that attempted to document the effects of suspended sediment on aquatic organisms. Their conclusion is that there is little agreement on the environmental effects of suspended sediment as a function of concentration and duration of exposure (Newcombe and MacDonald, 1991).

Water Temperature. All life stages of the covered species noted above require relatively cold to cool water. Suitable stream temperatures are maintained through a variety of mechanisms. In general, surface water temperatures are related to local air temperatures, except where influenced by groundwater. The primary factors affecting air temperature are elevation, aspect, latitude, humidity, wind, and sunlight. Stream temperatures also are affected by stream gradient, stream flow, and water source (groundwater, snowmelt, or rain). Tree removal generally reduces shade and humidity, and increases wind velocities and stream flow. A reduction in tree density and canopy closure in areas adjacent to streams might also affect stream temperature by allowing changes in microclimate variables, including increased air temperature, lower humidity, increased wind speed, and increased ground temperatures. Sediment input, particularly increases in fine sediment, can affect stream temperatures through changes in channel input morphology such as reduced pool volume and increased channel width (Rhodes et al., 1994; Lewis, 1998).

The principal source of heat for small mountain streams is solar radiation striking the surface of the stream (Brown, 1969). Flow can be affected if the removal of large areas of vegetation reduces the amount of surface water infiltration into the soil because of compaction (Chatwin et al., 1994). Although reduced infiltration is not directly related to temperature, the amount of groundwater reaching a stream over time can be affected. The temperature of groundwater is usually close to the average annual ambient air temperature of a region.

Water temperature increases resulting from timber harvesting are greatest during the low-flow periods in summer and early fall. During low flow, groundwater comprises most of the stream flow because input from other sources such as snowmelt has declined. Also, the travel time for water through a given stream reach is longer (because velocities decrease with decreasing flow), exposing the water to more solar radiation. Reductions in canopy cover because of timber harvesting could worsen this condition (Beschta et al., 1987).

Reductions in canopy cover may also decrease temperatures in late fall or early winter. Tree canopies moderate heat loss from streams when the air temperature is cooler than the water. A reduction in canopy cover accelerates heat loss, with the greatest effect on small streams, and little or no effect on wide rivers. Before ice begins to form on streams in late fall and early winter, rapid decreases in stream temperatures can occur during the night.

Changes in water temperatures from the removal of riparian vegetation may benefit or negatively impact salmonid populations. Among the potential benefits is a short-term increase in primary and secondary production that would increase the amount of available food. Studies have shown that after logging, increases in filamentous algae promoted the abundance of invertebrate grazers such as baetid mayflies, grazing caddisflies, and midges that were more likely to contribute to the insect drift and be available as food for salmonids (Hawkins et al., 1982).

Increased water temperatures during summer months as a result of logging can have negative impacts on salmonids (Beschta et al., 1987). These impacts can result in increased stress, and even death, during rearing; prevention or delay of upstream migration by adults; reduced resistance to diseases; poor growth of juveniles due to reduced metabolic efficiency; and shifts in the competitive advantage of salmonids over non-salmonid species (Hallock et al., 1970; Hughes and Davis, 1986; Reeves et al., 1987, Spence et al., 1996).

Dissolved Oxygen. Dissolved oxygen levels in forest streams are generally not a significant source of mortality for adult salmonids, but oxygen limitations can cause mortality while eggs and fry are in the gravels. Dissolved oxygen levels decline when water temperatures increase and stream flows decline. As water warms, it loses its capacity to hold or retain dissolved oxygen; at low flows, the surface mixing of water and air is minimal. A substantial reduction in canopy cover (shade), therefore, has the potential to reduce dissolved oxygen levels in streams if stream temperatures become elevated. Increased nutrient levels also can reduce dissolved oxygen levels by increasing the biological oxygen demand in the water. Tree removal near streams may result in nutrient loading through soil disturbance and the input of organic material. However, nutrient levels quickly return to normal levels following harvest activities (Chamberlain et al., 1991, in Quigley and Arbelbide, 1997). Hicks et al. (1991) concluded that there was no evidence of a major effect of logging on salmonids due to low dissolved oxygen concentrations in surface water.

Contaminants. Most aspects of forest management require the use of mechanized equipment. Where machinery is used, there is the potential for contamination of stream waters through accidental spills of fuels, oils, and other toxic materials. The potential risk and magnitude of pollution is related to the location and duration of the activity. Landings near streams have the greatest potential to deliver pollutants to streams because they are areas of concentrated activity. The application of pesticides, herbicides, and fire retardant also has the potential to introduce pollutants to streams. These contaminants are most likely to be introduced as aerosols and as chemicals are released through runoff from precipitation.

Forest practices can lead to changes in nutrient distribution and dynamics in upland areas, which in turn affect availability in streams (Spence et al., 1996). Harvest intensity (i.e., the proportion of forest canopy removed), type of harvest, and cutting frequency all affect the rate of nutrient removal from the system (Beschta et al., 1995). Despite the loss of nutrients stored in removed biomass, nutrients are generally more available to stream organisms in the years immediately following harvest (Spence et al., 1996). The addition of slash to the forest floor (Frazer et al., 1990), accelerated decomposition of organic litter resulting from increased sunlight reaching the ground (Beschta et al., 1995), and increased water availability for leaching of materials, increased surface runoff and erosion that contributes nutrients to the stream environment (Gregory et al., 1987) are largely responsible for this increase. As soils stabilize and revegetation occurs, the rate of nutrient input typically declines (Spence et al., 1996).

Studies have shown increases in plant nutrients (inorganics such as nitrogen, phosphorus, potassium, calcium) after logging, but these increases were shown to be moderate and for short time periods (Brown et al., 1973; Scrivener, 1982). The nutrient enhancement coupled with increases of solar radiation usually lead to increases in autotrophic production and possible increases in invertebrate grazer populations (Gregory et al., 1987). However, it is inconclusive if salmonid populations respond in either increased growth or numbers to nutrient increases (Gregory et al., 1987).

Effects of Forest Management on Physical Habitat

Harvesting trees causes changes in forest structure and landscape composition. Tree removal in riparian corridors reduces the potential for input of LWD and organic matter to a stream, and can reduce bank stability if trees are removed near the stream bank (Swanson et al., 1987; MBTSG, 1998). These changes have the potential to alter channel morphology and reduce stream habitat complexity. Water removal and culverts can also influence the quantity of available habitat and the ability of fish to move between habitats.

Large Woody Debris. Riparian areas provide numerous ecological functions that support aquatic ecosystems. Thinning and harvesting of timber in riparian areas reduces the availability of LWD that enters streams. In the past, timber harvesting has resulted in reductions of in-channel LWD and potential LWD by extensive clearing of stream channels, removal of most large conifers from the riparian zone, and short-rotation timber harvesting. These activities have altered the sources, delivery processes, and redistribution of woody debris in watersheds and have impacted the abundance and distribution of Pacific salmonids (Bisson et al., 1987; Maser and Sedell, 1994).

LWD provides complexity by adding woody cover or facilitating the creation of hydrologic features such as pools, gravel bars, and backwater areas. In small streams, gravel bars created by log jams or single pieces of LWD are sometimes the only suitable spawning gravels for long distances. Pools and backwater areas provide cover by virtue of deep water and provide refugia from high stream flows. These areas often are critical to the juvenile lifestage of salmonids and other fish species. Amphibians may also utilize pools and backwater areas during one or more life history stages. LWD provides nutrients to a stream as well as a substrate for aquatic invertebrate (insect) production (Bisson et al., 1987; Montgomery et al., 1996).

Bank Stability. Tree removal near streambanks may increase the potential for bank erosion, which can result in the loss of underbank habitat and decreased water depth. Many salmonid species, particularly adults, use undercut banks as holding habitat and feeding stations. Undercut areas provide fish refugia from main channel velocities, overhead cover from predators, and a place to feed on drifting aquatic and terrestrial insects and smaller fish. Undercut banks form when soils are scoured beneath vegetation or roots that hold the surface soils intact. Removal of trees along streambanks can eliminate or reduce the potential for this type of habitat. The root systems of trees near the banks also provide channel stability during periods of high flow, and reduce the potential for floodplain and streambank erosion (MBTSG, 1998).

Water Removal. Pumping and transporting water from streams for watering roads can potentially have adverse effects because of reduced stream flows and the entrainment of organisms, unless water intakes are appropriately screened. Reductions in stream flows during late summer and early fall are particularly important because stream flows are naturally low during this time of year. Fish that become entrained are essentially lost to the population.

Culverts. Culverts designed and built for water passage can be a barrier to fish movement. Culverts with an opening larger than necessary may create water depths too shallow for fish passage, especially during low-flow periods. Depending on the water velocity, extremely long culverts may preclude fish passage since fish cannot sustain high swimming speeds for long periods of time (Bell, 1986). Culverts with high slopes may create velocities during certain flows that are impassible by fish, regardless of culvert length. The last aspect of culverts is drop, which is the vertical distance from the discharge of the culvert into the stream. Depending on the distance, drop may preclude small fish from passage and even discourage larger fish from attempting passage (Bell, 1986).

Effects of Fire Management

To reduce fire hazards, fire prevention involves silvicultural practices such as thinning, salvage, and prescribed burning, and the construction of barriers such as fire breaks. Fire control involves mechanical and chemical methods of fire suppression.

Fire prevention and control, particularly from activities in or near riparian corridors, have the potential to affect several aquatic habitat functions. Examples of these effects include the following:

- Removal or reduction of LWD, which could reduce habitat complexity and alter stream channel configuration.

- Reduction in stream canopy cover, which could increase stream water temperatures.
- Promotion of hillslope mass wasting and surface erosion through the reduction of surface vegetation. This could cause increased surface erosion and sedimentation of streams, which could alter peak and low flows if it occurs over a large area.
- Use of chemical retardant to fight wildfires, which can kill fish and amphibians if applied on and near streams in sufficient quantities. There is also the potential for mortality of aquatic invertebrates and the increased nutrient input to downstream reaches, which could result in indirect effects of fire retardant on aquatic species.
- Fire plow lines and soil scarification, which could increase stream sedimentation.

Effects of Recreation and Fishing

Important values of most aquatic ecosystems are the recreational and fishing opportunities they provide. Maintenance of high-quality recreation values for many rivers, streams, and lakes is often a natural resource management goal of resource agencies. However, recreation and fishing activities can adversely affect fish populations and aquatic habitats as described below.

Introduction of Non-Native Fish Species. The introduction of non-native fish species is usually intended to create or expand fishing opportunities, but instead can adversely affect the native fish community. This can occur through specific species interactions, including competition, predation, and hybridization. Competition occurs over a wide range of ecological situations when two or more organisms compete for the same limited resource. It includes physical competition between individuals (Chapman, 1966), and niche specialization where one species is more efficient at using a habitat than another (Miller, 1967). Predation includes predation on one species by another, and predation by larger (older) fish on smaller ones of the same species. Hybridization and genetic introgression includes reproductive crosses between species that result in changes to the gene pool of one species (such as cutthroat trout/rainbow trout hybrids or introduction of genetic material from hatchery fish). All three interactions may affect native fish populations simultaneously.

Legal Fishing. Legal fishing has the potential to adversely affect local populations of native salmonids, primarily through incidental catch and habitat alteration. Incidental catch can result in unintentional angling mortality through wounding, stress, or the misidentification and unintentional harvest of some species. Wading by anglers can trample spawning redds and increase bank erosion. Trampling can result in the direct mortality of incubating fish eggs and recently emerged fry, while increased bank erosion can accelerate habitat degradation.

Illegal Fishing. One of the most detrimental activities on some species is illegal fishing or poaching. Laws and regulations are developed for certain species to protect sensitive life stages such as spawning adults, certain local populations that are depressed, or, in the case of threatened species, to prevent extinction. Poaching can severely impact fish populations by further reducing populations or sensitive life stages that are already depressed, and by directly killing individuals of a species.

Foot Traffic. Foot traffic can damage vegetation along lakes and streams, either directly through trampling or indirectly through soil compaction. Vegetation damage can lead to erosion and sedimentation, depending on the amount of activity, and can accelerate habitat degradation. Foot traffic through areas used for spawning (fish) or reproductive activities (reptiles and amphibians) can impact these species through disturbance of essential reproductive behaviors. Trampling of spawning redds can result in the direct mortality of incubating fish eggs and recently emerged fry.

Off-Road Use of Recreational Vehicles. The effects of off-road recreational vehicle use can alter plant community structure and create gaps in vegetation along shorelines and streams (Quigley and Arbelbide, 1997). The partial loss of vegetation can increase erosion along waterbodies. Also, use of off-road vehicles in streams may result in the direct destruction of redds, eggs, and possibly young fish.

3.5 Vegetation/Plant Species of Concern

3.5.1 Introduction

This section relies on data made available from Simpson, the California Natural Diversity Database (CNDD), CDFG, and USFWS. Data has been collected, assessed, and simplified for purposes of this EIS. This chapter describes vegetation contained within the coverage area for the Proposed Action and other action alternatives, as well as for all of the Simpson fee-owned lands within the Primary Assessment Area in northern California. Vegetation has been grouped into habitat type classifications. The frequency, composition, and spatial distribution of habitat types within Simpson's fee ownership within the Primary Assessment Area and the general character of the Primary Assessment Area have been characterized by data provided by Simpson.

Simpson uses a cover type classification system that focuses on merchantable timber for timber management purposes. Aerial interpretation and ground-truthing is performed according to the established criteria of this system. Biologists at Simpson have recently developed a computer algorithm that converts the merchantable timber cover type classification system into the California Wildlife Habitat Relationships (CWHR) System (Mayer and Laudenslayer, 1988). The CWHR system was used in this analysis to identify potential wildlife use within the Simpson ownership and to compare existing conditions with future wildlife habitat trends under each project alternative. The current habitat conditions are described below according to CWHR, with the exception of "bare land" and "unclassified," which are classes defined by Simpson. The habitat codes, size classes, and canopy closure classes in the CWHR system are defined in Table 3.5-1.

Unclassified land represents either areas that Simpson has never surveyed, since most of these areas are lands where some other entity has cutting rights, or lands not located within an HPA and not classified as rain-on-snow. Bare lands are areas where vegetation is absent, for any one of a number of reasons. These lands are mostly a collection of bare rock outcrops, major landslides, and rock pits (i.e., areas being mined for rock to use on roads).

The model used by Simpson biologists to convert Simpson timber type maps to CWHR classification has not been field-tested and is intended for general characterization purposes only. The classifications derived from the model are based on larger scale habitat characteristics; that is, small inclusions of a particular habitat type may be generally

TABLE 3.5-1
Definitions of CWHR Habitat, Size, Class, and Canopy Closure Class Codes

Habitat Codes	Definition
MHW	Montane Hardwood
CSC	Coastal scrub
DFR	Douglas-fir
MHC	Montane hardwood/conifer
RDW	Redwood
KMC	Klamath Mixed Conifer
LAC	Lacustrine
RIV	Riverine
UNCL	Unclassified
WTM	Wet Meadow
URB	Urban
BARE	Bare land
PGS	Perennial Grassland
Size Classes	**Definition**
1	Stand has a quadratic mean diameter of <1”
2	Stand has a quadratic mean diameter of 1”-5.9”
3	Stand has a quadratic mean diameter of 6”-10.9”
4	Stand has a quadratic mean diameter of 11”- 23.9”
5	Stand has a quadratic mean diameter of 24”- ≥32”
6	Stand has Size Class 5 trees over a distinct layer of Size Class 4 or 3 trees; total canopy closure is at least 60%
Canopy Closure Classes	**Definition**
S (sparse)	Stand has 10-24.9% total canopy closure
P (open)	Stand has 25-39.9% total canopy closure
M (moderate)	Stand has 40-59.9% total canopy closure
D (dense)	Stand has 60-100% total canopy closure

incorporated into another CWHR classification. Further, it is possible that some of the habitat within an HPA on the Simpson ownership is identified as Montane Riparian habitat. The algorithm is not able to distinguish this habitat type from other forest habitat types. Therefore, no Montane Riparian habitat has been identified in the data presented below. For the most part, Simpson does not have these narrow riparian zones mapped as distinct polygons in their geographic information system (GIS). As a consequence of the fact that much of Simpson’s property would qualify as a temperate rainforest, the riparian vegetation is not significantly different from the surrounding forest across much of the area. The distinctly unique riparian areas present within the ownership are either rare enough, or small enough, such that Simpson has not delineated them. The areas that have been classified as Riverine as opposed to Riparian, are legitimate riverine areas, consisting of large enough bodies of flowing water and their associated beds/bars (submerged in winter; exposed in summer). These areas have been typed out as polygons that are classified in the system as "non-forested waterways." While the CWHR classifications derived from the computer algorithm may be imprecise, they are sufficient for characterizing the Simpson ownership and for determining potential impacts from action and no action alternatives.

Sensitive plant species potentially occurring within the Primary Assessment Area and the Simpson ownership were identified by the following sources: the CNDD, Simpson observations, and discussions with USFWS and CDFG. Information from the CNDD was made available via regularly updated computer software called RAREFIND. Sensitive species lists were generated for each of the USGS 7.5' quadrangles (over 50 quadrangles, one million acres) containing the 11 HPAs and Simpson's California ownership outside the HPAs, which is predominately rain-on-snow areas. This information was then entered into an ACCESS database to associate species occurrence by HPA (or by USGS quadrangle if outside the HPAs).

3.5.2 Regional Setting

3.5.2.1 General Vegetative Character

Productive soils, moderate temperatures, and seasonally abundant moisture support a mixed cover of dense forest and prairie vegetation within the Primary Assessment Area. Redwood is the dominant tree on the relatively moist flood plains, low stream terraces, and lower hillslopes adjacent to the main channel. On the upper slopes, Douglas-fir is the dominant conifer associated with western hemlock, tanoak, and Pacific madrone.

Areas of natural prairie and woodland vegetation are intimately associated with forested areas throughout much of the Primary Assessment Area. The most common communities of nonforest vegetation are grass prairies, grass-bracken-fern prairies, oak-grass woodlands, oak-poison oak-grass woodlands, and oak-madrone-brush woodlands. The origin of the grass and grass-bracken-fern prairie is partly the result of hillslope mass wasting, natural fires and fires set by local Native American tribes, and lateral variability in soil parent materials (Swanston et al., 1995).

Eleven CWHR habitat types are present within the Simpson ownership. While it is unlikely, more habitat types may be present within the "Primary Assessment Area" that comprises the current ownership and lands that may be acquired by Simpson in the future. In addition to the 11 CHWR habitat types, Simpson has included two classifications to describe land cover within its ownership, including Bare Land (Bare) and Unclassified Land. Of the 13 habitat types that are present, however, only 5 are forested: Montane Hardwood (MHW), Klamath Mixed Conifer (KMC), Douglas-fir (DFR), Redwood (RDW), and Montane Hardwood Conifer (MHC). Five non-forested vegetative habitat types that are present and intermixed with the forested habitat types are Perennial Grassland (PGS), Wet Meadow (WTM), Riverine (RIV), Lacustrine (LAC), and Bare. Other non-forested habitat types that are present within the Simpson ownership include Coastal Scrub (CSC), Urban (URB), and Unclassified Land. CSC, URB, and Unclassified Lands are not generally associated with commercial timberlands. They are, therefore, not included in the Action Area or Primary Assessment Area (see Section 3.1), and not described or analyzed in detail in this EIS. Table 3.5-2 provides a breakdown of the distribution and abundance of the forested and

TABLE 3.5-2
Percent Composition of Habitat Type Within Simpson Ownership

	Acreage Distribution in Hydrographic Planning Areas												
CHWR Classification	**Smith River**	**Coastal Klamath**	**Blue Creek**	**Interior Klamath**	**Redwood Creek**	**Coastal Lagoons**	**Little River**	**Mad River**	**N. Fork Mad River**	**Humboldt Bay**	**Eel River**	**Non-HPA (Rain-on-snow)[a]**	**Total Ownership Acreage**
Montane Hardwood	4.93%	3.71%	3.56%	30.46%	15.14%	0.31%	0.43%	14.62%	4.67%	0.14%	0.91%	15.73%	10.03%
Klamath Mixed Conifer	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08%	0.004%
Douglas-Fir	12.94%	4.53%	8.72%	28.96%	28.34%	10.81%	5.67%	20.38%	21.79%	1.65%	4.34%	25.02%	15.59%
Redwood	50.16%	72.51%	63.25%	9.10%	35.04%	86.99%	89.43%	40.39%	52.07%	96.11%	92.59%	2.69%	52.27%
Montane Hardwood Conifer	26.71%	16.42%	18.98%	27.55%	16.42%	0.74%	4.10%	13.16%	18.94%	0.24%	0.51%	55.17%	18.06%
Riverine	1.15%	0.56%	3.48%	0.21%	0.70%	0.22%	0.00%	1.41%	0.75%	0.00%	0.71%	0.12%	0.68%
Bare	0.01%	0.07%	0.09%	0.09%	0.07%	0.38%	0.17%	0.08%	0.06%	0.04%	0.01%	0.01%	0.09%
Coastal Scrub	3.52%	1.98%	1.75%	1.46%	0.19%	0.37%	0.03%	0.25%	0.08%	0.27%	0.07%	0.04%	1.11%
Perennial Grassland	0.15%	0.07%	0.16%	1.91%	1.04%	0.04%	0.18%	9.71%	0.48%	0.61%	0.24%	0.34%	1.59%
Wet Meadows	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.004%
Urban	0.37%	0.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.17%	0.00%	0.00%	0.00%	0.14%
Unclassified	0.07%	0.00%	0.00%	0.26%	3.02%	0.10%	0.00%	0.00%	0.00%	0.95%	0.62%	1.80%	0.44%
Lacustrine	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.002%

[a]Simpson ownership outside of the 11 HPAs

non-forested habitat types within the Simpson ownership. Figure 3.5-1 provides a graphic display of the habitat types within the Simpson ownership as distributed throughout the 11 HPAs.

More than 95 percent of the Simpson ownership is forested, with RDW being the most common forest habitat type. RDW is also the most common habitat type of all habitats present. It represents about 53 percent of the acreage found within forested habitat types. RDW is followed in percent composition by DFR (17.1 percent), MHC (18.3 percent), and MHW (11.6 percent). KMC only accounts for about 20 acres. KMC is only found in the rain-on-snow areas of Simpson's ownership. RDW, DFR, MHW, and MHC are found in all 11 HPAs. DFR, KMC, and MHW are found primarily within the eastern portion of the Simpson ownership. Whereas, as expected, RDW and MHC are found primarily along the western portion, or closer to the coast. MHC is found only in the northwestern portion of the Simpson ownership.

The primary hardwood species that are represented within the MHW and MHC habitat types are red alder, tanoak, Pacific madrone, Oregon white oak, and black oak. Red alder is the dominant overstory species in the riparian areas. Tanoak and Pacific madrone occur along ridge lines and mid-slope areas and are intermixed with conifers. Oregon white oak and black oak occur in the drier transition zones between Douglas-fir forests and prairies.

A long history of logging in the region has resulted in a mixture of even-aged stands. Using GIS data and CDFG's CWHR criteria, the general stand composition and structure within the Simpson ownership were determined. Approximately 17 percent of the Simpson ownership within the 11 HPAs and the rain-on-snow areas is characterized by age classes greater than 60+ years. Most of the older vegetation is located within the Coastal Lagoons and Mad River Hydrographic Regions and the Little River Hydrologic Unit (see Figure 3.5-2) Other general, regional characteristics include:

- About 69 percent of the Simpson ownership within the 11 HPAs and the rain-on-snow areas is classified as CWHR size class 1-3
- Approximately 24 percent of the Simpson ownership within the 11 HPAs and the rain-on-snow areas is forest habitat classified as CWHR size class 4, stands with an average diameter at breast height (dbh) between 12 and 24 inches
- More than 62 percent of the forested habitat within the Simpson ownership within the 11 HPAs and the rain-on-snow areas has dense canopy closure

3.5.2.2 CWHR Classifications

Klamath Mixed Conifer

The KMC habitat type is restricted to the Klamath region of northern California and southwestern Oregon. It occurs along the eastern boundaries of Del Norte and Humboldt counties at elevations from 4,500 to 7,000 feet, often on steep slopes or in narrow valleys. While very similar to the mixed conifer type, it is distinguished by its higher species diversity. Douglas-fir and white fir are the dominant tree species, with Shasta red fir, lodgepole pine, Jeffrey pine, mountain hemlock, western white pine, Brewer spruce, canyon live oak, and black oak also included in the community. The understory is comprised of a rich shrub layer including: chinquapin, Sierra laurel, Saddler oak, dwarf rose, manzanita, huckleberry, oak, snowberry, and Oregon grape, as well as a well-developed and diverse herbaceous layer.

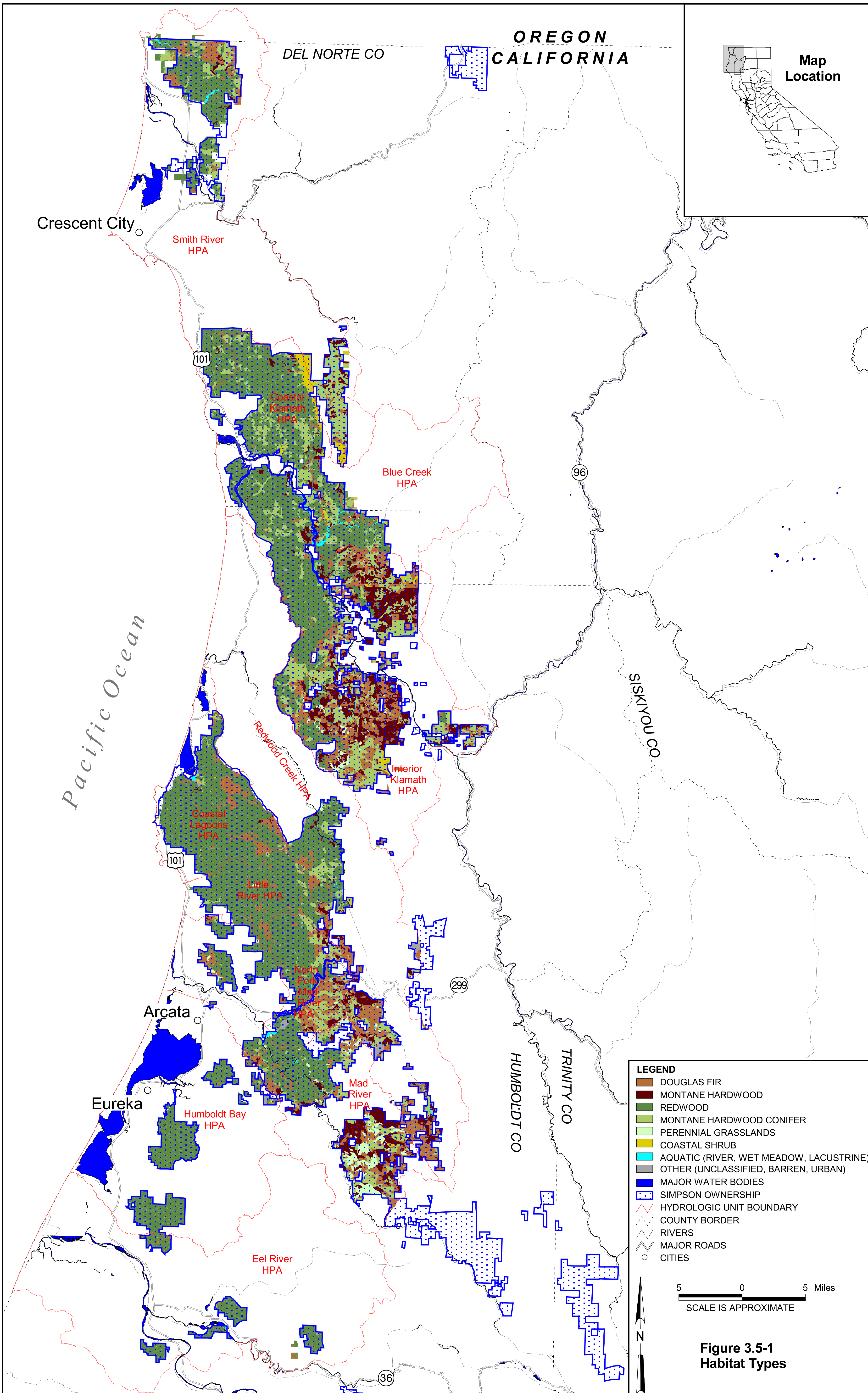


Figure 3.5-1
Habitat Types

CH2M Hill RDD ArcView Project File \\thor\cart1\rddgis\iid\ 1:42 p.m. 02-27-2002

CH2MHILL

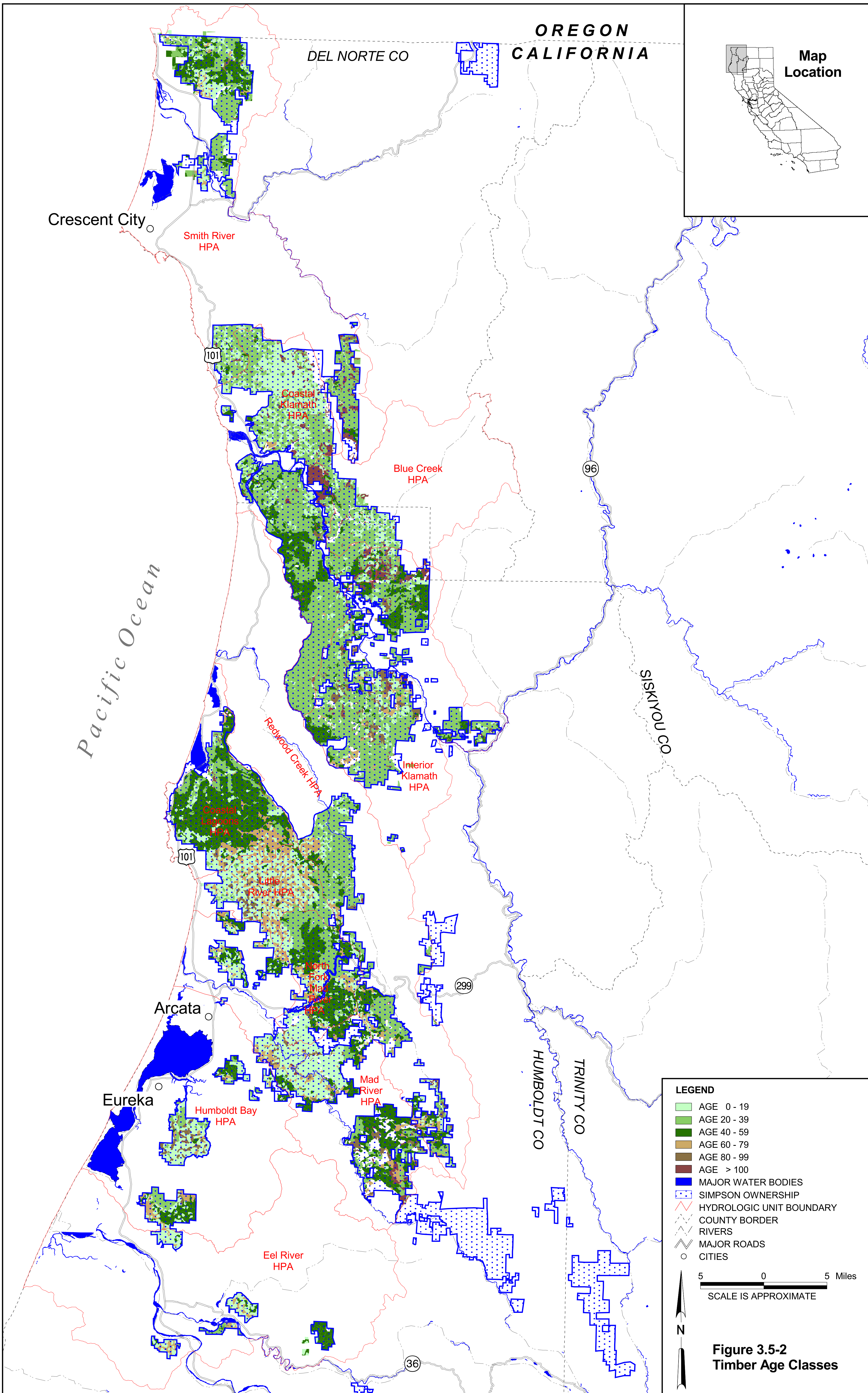


Figure 3.5-2
Timber Age Classes

Following disturbance, a dense community of montane chaparral develops from seeds in the soil seed bank. If adequate seed sources are present, a dense stand of young conifers follows the shrub stage within 20 to 30 years. The successional stages are often dependent on the type and frequency of disturbance as well as site-specific environmental factors. The communities are considered to be relatively well adapted to low intensity fires; however, intense or frequent fires may result in continued dominance of the montane chaparral type.

KMC represents less than 20 acres of the Simpson ownership, and is found only in the rain-on-snow areas. All habitat present has been classified as KMC1P (size class 1, open).

Douglas-Fir

The DFR type is widespread throughout northwestern California, including Del Norte and Humboldt Counties, at elevations ranging from 500 to 2,000 feet. Douglas-fir is the characteristic dominant species and associated species of conifers and hardwoods vary depending on soils, moisture, topography and disturbance history. On dry, steep slopes, canyon live oak is frequently abundant, but other trees, shrubs and herbs are sparse. In moderately dry areas, tanoak, Pacific madrone, sugar pine, ponderosa pine, and black oak are common components of the canopy, with Oregon grape, California blackberry, dwarf rose, and poison oak occurring in the shrub layer. Forbs and grasses include Pacific trillium, western swordfern, insideout flower, broadleaf starflower, deer vetch vanillaleaf, bracken fern, western fescue, common beargrass, and whitevein shinleaf. On the wettest sites, Port Orford cedar and Pacific yew are present in the canopy and common shrubs include vine maple, California hazel, and Pacific rhododendron.

Following disturbance, resprouting tanoak typically dominates with various other shrubs and forbs. In moist areas where young Douglas-fir are present in the tanoak community, the shrubs are generally overtopped by the trees in 15 to 30 years. The shrub community may persist for 60 to 100 years on dryer sites. Snags and downed logs, an important structural component of this habitat, increase in density or volume with stand age. In the absence of fire or other disturbance, western hemlock may occur as a codominant with Douglas-fir and tanoak in areas transitional to redwood forests. In the absence of disturbance, climax stands typically develop in 80 to 250 years.

DFR represents about 15.6 percent of the Simpson ownership within the 11 HPAs and the rain-on-snow areas, with about 68,241 acres recorded. Most of this acreage (28 percent) is found in the Interior Klamath HPA. This habitat type is also abundant in the Redwood Creek Hydrologic Unit and Mad River Hydrographic Region. Nearly 60 percent of the DFR habitat type is found within the eastern portion of the Simpson ownership. Very little of the DFR habitat type is found within the Humboldt Bay and Eel River HPAs located in the southern portion of the Simpson ownership (287 and 344 acres, respectively). About 68 percent of this habitat type is characterized as size class 1 through 3, with the remaining 32 percent characterized as size class 4 through 6. Size class 6 accounts for only about 3.9 percent of the DFR habitat. Size class 3 is the most abundant, accounting for about 36 percent of this habitat type. The next most abundant class (32 percent) is class 1. About 57 percent of this habitat type is characterized as having a dense canopy.

Redwood

The RDW habitat type refers to the mixed conifer forests that occur in the moist coastal environments at elevations ranging from sea level up to 3,000 feet. Redwoods are found throughout this range, but are only dominant in a narrow band within ten miles of the coast. Further inland, Douglas-fir becomes the dominant canopy species. Common associated species include sitka spruce, grand fir, Pacific madrone, and tanoak. Western red cedar and western hemlock are present, but are not significant species in the canopy. The moist climate and fertile soils result in a generally lush understory growth of shrubs, ferns, herbs, and grasses. Common understory species include barbary salal, coast rhododendron, ocean spray, huckleberry, snowbrush, ceanothus, sword fern, deer fern, and salmonberry.

This habitat type typically recovers rapidly from disturbance. Within 10 years, the early herbaceous vegetation is replaced by shrubs and redwood sprouts. Within 30 to 60 years, the shrub stage is followed by a mixture of conifers and hardwoods, with persistent shrubs remaining in the understory. A mature stand, dominated by redwoods with a second canopy layer of Douglas-fir requires at least 150 years to develop.

RDW represents about 52 percent of the Simpson ownership in the 11 HPAs and the rain-on-snow areas, with 228,784 acres recorded. Most of this acreage (nearly 28 percent) is found in the Coastal Klamath Hydrographic Region. The Coastal Lagoons Hydrographic Region contains another 15 percent of this habitat type. Redwood is least common in the Interior Klamath Hydrographic Region and the rain-on-snow areas. While only 3.2 percent of the total RDW type is found within the Eel River Hydrographic Region, RDW accounts for over 92 percent of the habitat found within this HPA. About 60 percent of the RDW habitat type is characterized as size class 1 through 3, with the remaining 40 percent characterized as size class 4 through 6. Size class 6 accounts for less than 1 percent of the RDW habitat type. Size class 1 is the most abundant, accounting for approximately 38 percent of this habitat type. The next most abundant class (33 percent) is class 4. About 53 percent of the RDW habitat type within the Simpson ownership is qualified as having a dense canopy.

Montane Hardwood Conifer

The MHC habitat type occurs throughout California and occurs extensively in both Del Norte and Humboldt counties on coarse, well-drained soils, at elevations ranging from 1,000 to 4,000 feet. This habitat type is a transition between the conifer dominated forests and the montane hardwood and is distinguished by having at least a third of the canopy species comprised of hardwoods and at least a third conifers. Typical canopy species include ponderosa pine, Douglas-fir, incense cedar, black oak, tanoak, Pacific madrone and golden chinquapin.

The multi-layered dense canopy precludes much understory vegetation; however, shrubs often become abundant following disturbance. Immediately after disturbance resprouting hardwoods dominate with a tall stand of mixed conifers and hardwoods developing within 15 to 20 years. The conifers generally grow faster, reaching moderate size in 30 to 50 years, while the hardwoods require 60 to 90 years to fully recover.

MHC represents about 18 percent of the Simpson ownership in the 11 HPAs and the rain-on-snow areas, with 79,050 acres recorded. Most of this acreage (about 23 percent) is found in the Interior Klamath Hydrographic Region. The Coastal Klamath Hydrographic Region contains another 18 percent and the Smith River Hydrographic Region contains

14 percent of this habitat type. Rain-on-snow areas contain more than 17 percent of this habitat type on the Simpson ownership. MHC is least common in the southern portion of the Simpson ownership, where the Eel River and Humboldt Bay Hydrographic Regions each contain less than 0.10 percent of the habitat type. About 88 percent of this habitat type is characterized as size class 3, with the remaining 12 percent characterized as size class 4 through 6. Size class 6 accounts for a little over 2 percent of the MHC habitat type on the Simpson ownership in the 11 HPAs and rain-on-snow areas. About 89 percent of the MHC habitat type within the Simpson ownership is characterized as having a dense canopy.

Montane Riparian

Although not specifically delineated by Simpson (given the small scale of this habitat type relative to the Primary Assessment Area), the MRI habitat type likely occurs within the Primary Assessment Area. This diverse habitat type occurs throughout the Klamath, Cascade, Coast and Sierra Nevada Mountains on seasonally flooded or saturated soils at elevations up to 8,000 feet. Winter deciduous broad-leaf trees dominate the canopy. The vegetation structure is variable depending on specific site conditions and shrubs may be common or sparse. In the northern coast range, including Humboldt and Del Norte counties, the sub-type of this habitat is dominated by red alder. Associated riparian canopy species include: black cottonwood, bigleaf maple, dogwood, Sitka spruce, Hooker willow, Arroyo willow and box elder. The herbaceous layer is generally lush and frequently dominated by ferns. The transition to non-riparian vegetation is frequently abrupt. This habitat type is relatively stable but may contain a mosaic of stages depending on the flood history.

Perennial Grassland

Perennial grassland habitat type, also known as coastal prairie, are restricted to the central and northern coastal areas, occurring within 65 miles of the shoreline at elevations up to 3,300 feet. This habitat type often occurs on ridges and south-facing slopes intermixed with forest and scrub habitats. Native perennial bunchgrasses, such as California oat grass, Pacific hairgrass, and Idaho fescue are common, as well as several non-native perennial and annual grasses, including sweet vernal grass, redtop, Kentucky bluegrass, and softcress. Bracken fern, coast carex, and numerous forbs are also present in this habitat type.

Considered to be relatively stable under natural disturbance regimes, overgrazing, fire suppression, cultivation, and the introduction of non-native species have significantly impacted PGS.

PGS represents approximately 1.6 percent (or 6,972 acres) of the Simpson ownership in the 11 HPAs and rain-on-snow areas and is mostly (69 percent) found in the Mad River HPA. This HPA, in addition to the Interior Klamath HPA, comprises over 87 percent of this habitat type within the Simpson ownership. This habitat type is least common in the Coastal Lagoons Hydrographic Region, where only 16 acres are recorded.

Wet Meadows

Wet meadows occur extensively throughout the Sierra Nevada and Klamath Mountain ranges at elevations ranging from 4,600 to 6,000 feet on soils saturated throughout the growing season. This type occurs in northern Humboldt County and throughout Del Norte County. The herbaceous layer is composed of a rich diversity of grasses, sedges, rushes, and forbs with shrubs and trees sparse or absent. Important species include thingrass, abruptbeak sedge, Nebraska sedge, tufted hairgrass, needle spikerush, Nevada rush, iris leaf rush, pullup muhly, and panicled bulrush. Willow and bilberry are the only shrubs that may occur in any significant abundance.

Long-term succession eventually leads to replacement of wet meadows with forests; however, significant disturbance, such as overgrazing or altered hydrology, is generally required to allow tree invasion to occur.

This habitat type represents only 18 acres of the Simpson ownership and is all found within the Coastal Lagoons Hydrographic Region.

Riverine

This classification refers strictly to waterways and is specifically described in Section 3.3 (*Hydrology and Water Quality*) of this EIS. Although the Simpson GIS system does not include riparian zones around these riverine habitats, Simpson has completed numerous field studies to determine riparian habitat characteristics within the Primary Assessment Area and the ownership. Riparian vegetation in the coastal watersheds of northern California support a diversity of tree species including alder, willows, western red cedar, coastal redwood, sitka spruce, Douglas-fir, western hemlock, and big leaf maple. Channel habitat typing and assessment within the Primary Assessment Area and Simpson ownership was conducted on 41 stream reaches for nearly 60 miles of stream channel. Canopy closure, as measured from the center of the stream, ranged from 70 percent to 95 percent in seven out of eight sub-basins sampled. Canopy closure was only 34 percent in one sub-basin due to a recent wildfire. Species composition within 50 feet of the bankfull channel was predominantly deciduous (69 percent to 91 percent) along all eight streams. The shift in composition favoring deciduous species is due in part to past harvesting practices and current restrictions on management activities within riparian areas. The predominant species observed in the riparian areas was red alder.

Lacustrine

Lacustrine habitats are inland depressions or dammed riverine channels containing standing water. This habitat type represents only 8 acres within the Simpson ownership, and is found entirely in the Redwood Creek Hydrologic Unit.

Bare Ground

This land cover type includes rock pits, slides and outcrops. Only 0.09 percent or 415 acres of this land cover type is found on the Simpson ownership within the 11 HPAs and rain-on-snow areas. This type is mostly (36 percent) found in the Coastal Lagoons. Rain-on-snow areas, Smith River, Eel River and Humboldt Bay Hydrographic Regions have the fewest acres of this habitat type with only 2, 3, 0.5 and 6 acres, respectively.

3.5.3 Hydrographic Planning Area Setting

Table 3.5-2 presents the percent composition of each habitat type within Simpson ownership and by HPA. A brief characterization of the Simpson ownership within each HPA is provided below.

3.5.3.1 Smith River Hydrographic Region

The Smith River Hydrographic Region is heavily forested, except for areas on the coastal plain that support agricultural and urban development. Although this HPA is at the north end of the range of redwood, this species is the dominant component of most cover types. Sitka spruce is a major stand component on coastal aspects, and Douglas-fir is the principal constituent of many stands in the more inland portions of this HPA. Western hemlock, western red cedar, and grand fir occur as minor stand components on lower slopes near the coast. Red alder dominates most riparian zones and many lower slopes on north to east aspects throughout this area. Tanoak and madrone are common on drier sites toward the interior, particularly upper slopes with south to west aspects. Stand ages vary from recently planted harvest units to 60-year-old second-growth forests.

The Simpson ownership within this HPA is primarily composed of the RDW (50.2 percent) and MHC (26.7 percent) habitat types. DFR represents 12.9 percent of the Simpson ownership in this HPA. Other habitat types each comprise less than 5 percent of Simpson ownership within the HPA.

3.5.3.2 Coastal Klamath Hydrographic Region

The Coastal Klamath Hydrographic Region is dominated by redwood and redwood / Douglas-fir forests, with Sitka spruce occupying a narrow strip of westerly aspects along the coast and some lower slopes for a short distance inland. The redwood / Douglas-fir forests also include grand fir, western red cedar, and western hemlock on lower slopes and in riparian zones. Red alder is the most common hardwood in riparian zones, and tanoak is the most common mid- to upper-slope hardwood, with pacific madrone occurring as a minor stand component on drier sites. As distance from the coast increases, the proportion of redwood in stands decreases and Douglas-fir and tanoak become more prevalent. Ridge tops and upper south to west slopes in the most inland reaches can support nearly pure Douglas-fir or tanoak / madrone stands.

Due to a band of serpentinaceous soils on the Red Mountain–Rattlesnake Mountain ridge that forms the divide between Turwar Creek and Goose Creek, a distinct ecotone occurs around 2,500 to 3,000 feet elevation where redwood and Douglas-fir forest rapidly gives way to a non-forest landscape dominated by manzanita, with knobcone pine, ponderosa pine, and Port Orford cedar at the transition and persisting upslope in the bottom of many watercourses.

A few isolated small stands of old growth exist on Simpson’s property within this HPA, in addition to those in state and federal parks situated within a few miles of the coast. Most of the forests in this HPA were harvested between the 1930s and the 1970s, and stand ages reflect that history.

The RDW habitat type comprises by far the greatest amount of Simpson acreage within this HPA with about 72.5 percent coverage. MHC comprises about 16.4 percent of the Simpson ownership in this HPA. Other habitat types each comprise less than 5 percent of Simpson acreage within the HPA.

3.5.3.3 Blue Creek Hydrologic Unit

Blue Creek's elevation range (50 ft. to 5,700 ft.) and its location at the inland edge of summer fog intrusion provide for a diverse association of forest types. At the mouth of Blue Creek, coastal redwood / Douglas-fir forest predominates, and redwood persists nearly to Simpson's property line, approximately 7 miles upstream. Six Rivers National Forest owns the entire HPA above Simpson's property, and the forest there progresses from Douglas-fir / tanoak at lower elevations to a montane conifer forest more typical of the Klamath Mountains at higher elevations, with Douglas-fir and white fir the primary overstory species. As in the Coastal Klamath Hydrographic Region, serpentinaceous soils on South Red Mountain generate a vegetative cover type above 2,500 to 3,000 feet that is dominated by manzanita, with knobcone pine, ponderosa pine, and Port Orford cedar at the transition and persisting upslope in the bottom of many watercourses. This same soil-vegetation complex occupies over much of the Slide Creek subwatershed that is mostly within the National Forest on the south slope of Blue Creek.

Timber harvesting operations began around 1960 in this HPA, and by 1990 all but scattered remnants of the original forest on Simpson's property had been harvested. Very little timber harvesting has occurred within the 80 percent of this watershed owned by the National Forest, and roughly 40 percent of that ownership is in the Siskiyou Wilderness Area.

Simpson ownership within this HPA is primarily composed of the RDW (63.3 percent) and MHC (about 19 percent) habitat types. DFR comprises about 8.7 percent, and other habitat types each comprise less than 4 percent of the HPA area owned by Simpson.

3.5.3.4 Interior Klamath Hydrographic Region

The Interior Klamath Hydrographic Region spans the transition from coastal redwood / Douglas-fir forests to more mesic interior landscapes that are dominated by Douglas-fir / tanoak forests, with grasslands appearing on some drier ridge tops and south to west aspects. On the east side of the Klamath River, redwood only occurs north of Cappell Creek and only on lower slopes along the river face. On the west side of the Klamath, redwood persists to the Redwood Creek divide in Roach Creek and throughout the area north and west of this tributary. Higher elevations at the eastern boundary of this Region (4,000 to 4,500 feet) support montane conifer forests dominated by Douglas-fir and white fir.

Red alder occurs in riparian zones along lower stream reaches throughout the region, and golden chinquapin can be found as a stand component on more xeric sites. Oregon white oak is common at the margins of grasslands, with California black oak also found on drier

With the exception of the areas along the western margin of this HPA that are in Six Rivers National Forest, and some fragmented stands on the Hoopa Indian Reservation, most of the forest in this area is young growth originating from timber harvesting activities that occurred between the 1940s and the 1980s.

Simpson's ownership within this HPA is primarily comprised of three habitat types in near equal portions: DFR (29 percent), MHC (27.6 percent), and MHW (30.5 percent). Only about 9.1 percent of Simpson's lands within this HPA are comprised of the RDW habitat type. Other habitat types each comprise less than 2 percent of Simpson land within this HPA.

3.5.3.5 Redwood Creek Hydrologic Unit

The Redwood Creek Hydrologic Unit supports cover types that range from Sitka spruce / Douglas-fir forest at the coast to Douglas-fir / white fir forest at the watershed's origin, 46 miles south-southeast of its mouth.

The redwood / Douglas-fir forest also includes grand fir, western red cedar, and western hemlock on lower slopes near the coast and in riparian zones. Red alder is the most common hardwood in riparian zones, and tanoak is the most common mid- to upper-slope hardwood.

Aspect strongly affects the distribution of redwood within the watershed. Redwood persists roughly halfway up the west side of the drainage, but only one-third of the way up the east side. The drier regime created by the west facing slope also leads, along with soil type differences, to the appearance of natural grasslands on the east side of the drainage approximately 10 miles from the mouth of Redwood Creek, while they do not appear on the west side until south of Highway 299, approximately two-thirds of the way up the drainage. These grasslands and associated true oak woodlands become more prominent in the upper portion of the watershed, leading to a history of agricultural use — principally livestock grazing — since settlers arrived.

The middle to upper reaches of Redwood Creek transition rapidly to Douglas-fir / tanoak forest at the limits of the redwood forest, and white fir becomes prevalent near the watershed's 5,300-foot crest.

Agricultural development and the small town of Orick on the alluvial plain between Redwood Creek's estuary and the mouth of Prairie Creek constitute the only significant conversion of native forest to other uses within the drainage. Except for that area, roughly the lower third of the drainage is in Redwood National Park and Prairie Creek State Park. These parks support 25,000 acres of old growth, uncut coniferous forest, principally redwood and redwood / Douglas-fir types and another 1,800 acres where logging has occurred but over 50 percent of the original stand remains. The remainder of the forested area within the watershed has been harvested since the 1930s, with very few sites that support any significant remnants of the original forest.

Simpson's ownership within this HPA is primarily comprised of the RDW habitat type (35 percent), and the DFR habitat type (28.3 percent). The MHC and MHW habitat types together comprise about 31 percent of Simpson ownership in this HPA. This HPA contains the only known occurrence of the LAC habitat type within the 11 HPAs and rain-on-snow areas.

3.5.3.6 Coastal Lagoons Hydrographic Region

The Coastal Lagoons Hydrographic Region encompasses the coastal drainages between Redwood Creek and Little River, its inland extent being defined by the divide into those drainages. As it extends only 10 miles inland and crests at 2,800 feet elevation, the entire HPA is within the zone of summer fog intrusion, and all vegetative types therefore reflect a strong coastal influence.

Aside from coastal scrub and wetland vegetation around the lagoons, and residential development along U.S. Highway 101 (including the town of Trinidad), the entire HPA is forested. Sitka spruce and Douglas-fir / spruce forests along the coast rapidly give way to redwood and redwood / Douglas-fir forests that persist to the eastern boundaries of the HPA. Minor amounts of grand fir, western red cedar, and western hemlock occur on lower slopes near the coast and in riparian zones. Red alder dominates many riparian zones, and tanoak is the most common mid- to upper-slope hardwood.

The RDW habitat type comprises nearly 87 percent of the Simpson ownership in this HPA, while the next most abundant habitat type is DFR with about 10.8 percent. Other habitat types each comprise less than 1 percent of the HPA. This HPA contains the only occurrence of the WTM habitat type found within the 11 HPAs and rain-on-snow areas.

3.5.3.7 Little River Hydrologic Unit

The Little River Hydrologic Unit extends inland from the coast approximately 12 miles and reaches an elevation of 3,360 feet. Aside from residential and agricultural development along U.S. Highway 101, the entire unit is forested, with no natural prairies or other non-forest openings.

Sitka spruce and Douglas-fir / spruce forests along the coastal face give way within a mile or two of the coast to redwood and redwood / Douglas-fir forests. Minor amounts of grand fir, western red cedar, and western hemlock occur on lower slopes near the coast and in riparian zones. All but the extreme eastern tip of the Unit, approximately the last mile or two of the main stem of Little River, is within the zone of summer fog intrusion. This area supports redwood as a significant, if not dominant, stand component. Above the limit of fog intrusion, Douglas-fir and tanoak dominate the landscape. Red alder is the most common hardwood found in riparian zones throughout the Unit.

The RDW habitat type comprises about 89 percent of Simpson lands within this HPA. The next most abundant habitat types are DFR and MHC with about 5.7 percent and 4.1 percent coverage, respectively. Other habitat types each comprise less than 0.5 percent of Simpson land within this HPA.

3.5.3.8 Mad River Hydrographic Region

The Mad River Hydrographic Region extends inland from the coast approximately 26 miles and reaches an elevation of 5,200 feet. It encompasses a range of vegetative types from coastal scrub and Sitka spruce forest to Douglas-fir / white fir forests at elevations above 4,000 feet in the extreme southeastern corner of the HPA.

Redwood / Douglas-fir forests dominate roughly the lower two-thirds of the HPA. This habitat type also includes grand fir, western red cedar, and western hemlock on lower slopes near the coast. Red alder is the most common hardwood in riparian zones, and tanoak is the most common mid- to upper-slope hardwood, with pacific madrone occurring as a minor stand component on drier sites. As distance from the coast and elevation increase, the proportion of redwood in stands decreases and Douglas-fir and tanoak become more prevalent, with these species dominating the landscape at elevations above 2,000 feet. Occasional incense cedar are also found at higher elevations along the western boundary of the HPA.

Extensive prairies are particularly distinctive features on south- to west-facing slopes and ridgetops in the upper one-third of the HPA. In this area California black oak forms nearly pure stands as an ecotone between prairies and Douglas-fir forest.

Timber harvesting in this HPA began in the late 1800s near the coast as white settlers arrived. By 1930 almost all the redwood type had been harvested. The Douglas-fir dominated forests in the upper reaches of the HPA were not extensively logged until the 1940s, and by 1970, very little timberland remained in the HPA that had not been logged. Harvesting of mature second-growth forests was initiated in the lower reaches of the HPA in the 1960s.

The RDW habitat type comprises about 40 percent of this HPA. The next most abundant habitat type is DFR with about 20 percent coverage. The MHC and MHW habitat types together comprise about 28 percent of Simpson ownership in this HPA. Nearly 10 percent of the Simpson ownership in this HPA is characterized as PGS.

3.5.3.9 North Fork Mad River Hydrologic Unit

The North Fork Mad River Hydrologic Unit is one of the most heavily forested HPAs. All but an estimated 300 acres of natural grassland was in forest cover at the time of white settlement. The only changes in land use that have occurred since that time include Simpson’s mill complex at Korbel, the right-of-way for State Highway 299 that bisects the Unit, and a portion of the town of Blue Lake.

The mouth of the North Fork is located approximately 8 miles from the coast, and its eastern-most edge is roughly 13 miles inland. Its elevation ranges from 200 feet to 3,400 feet. Redwood occurs to around 2,200 feet in elevation throughout most of the Unit. A notable exception, undoubtedly due to soil characteristics, is a band of Douglas-fir dominated forest on both sides of the drainage that begins just above Korbel and persists to a line across the watershed approximately where Highway 299 crosses the North Fork. This area contains only occasional individual redwoods, regardless of elevation, and has a higher proportion of western red cedar and western hemlock on lower slopes and in riparian areas than would normally be expected this far inland.

Higher elevations along the eastern and southern boundary of this unit are forested entirely with Douglas-fir and tanoak, either in relatively pure stands or associated in mixed stands. Red alder occurs in riparian zones throughout the unit, except at the highest elevations.

The RDW habitat type comprises about 52 percent of the Simpson ownership in this HPA, with the next most abundant habitat type being DFR with about 21.8 percent coverage, followed by MHC with 18.8 percent coverage. Other habitat types each comprise less than 5 percent of lands ow ned by Simpson within this HPA.

3.5.3.10 Humboldt Bay Hydrographic Region

The Humboldt Bay Hydrographic Region encompasses Humboldt Bay and the four major streams that drain into it: Jacoby Creek, Freshwater Creek, Elk River, and Salmon Creek. As its eastern boundary is only 14 miles inland, and elevation does not exceed 2,800 feet, the entire HPA is within the zone of summer fog intrusion and all vegetative types reflects a strong coastal influence. Natural grasslands that typify the inland reaches of most HPAs exist as only a few small prairies at the extreme eastern margin of the HPA, on or near the divide into the Mad River and Eel River drainages.

This HPA is the most heavily populated by people. Residential, commercial, and agricultural development have eliminated or drastically altered most of the natural vegetative communities on the coastal plain, and have significantly impacted most estuarine habitats. Although hillsides adjacent to the coastal plain still retain much of the indigenous redwood / Douglas-fir / red alder forest, residential development permeates all but the steepest slopes surrounding the cities of Arcata and Eureka.

Outside of developed areas, redwood / Douglas-fir forests dominate, and persist to the eastern boundaries of the HPA. Spruce is common near the coast, and minor amounts of grand fir, western red cedar, and western hemlock occur on lower slopes and in riparian zones. Red alder dominates many riparian zones, and tanoak is the most common mid- to upper-slope hardwood.

The predominant habitat type on the Simpson ownership within this HPA is RDW with about 96.1 percent of the ownership in this habitat type. Other habitat types each comprise less than 2 percent of lands owned by Simpson within this HPA.

3.5.3.11 Eel River Hydrographic Region

The Eel River Hydrographic Region extends 27 miles inland and reaches an elevation of 3,700 feet at Iaqua Buttes, on the divide into the Upper Mad River Hydrographic Region. Dune and salt marsh vegetation at the estuary give way to agricultural development that has occurred throughout the extensive floodplain of the lower Eel and Van Duzen Rivers. Urban development has been restricted to a few small communities and a strip of residential development along Highway 36 in the lower Van Duzen.

Above the alluvial plain, forest cover dominates, with the usual progression of redwood / Douglas-fir forests near the coast to Douglas-fir and Douglas-fir / tanoak forests in the interior. Spruce is common on coastal faces and at the margins of the coastal plain, and minor amounts of grand fir, western red cedar, and western hemlock occur on lower slopes and in riparian zones. Red alder dominates many riparian zones, and tanoak is the most common mid- to upper-slope hardwood. Other common hardwoods are California laurel (pepperwood), Pacific madrone, and California black oak.

Extensive prairies become prevalent in the most inland portions of the HPA, dominating many south to west slopes and ridge tops. Nearly pure stands of California black oak commonly form a transition type between prairies and conifer forest.

The predominant habitat type on the Simpson ownership within this HPA is RDW with about 92.6 percent of the ownership in this habitat type. The DFR habitat type covers approximately 4.3 percent of the Simpson ownership in this HPA. Other habitat types each cover less than 1 percent of lands owned by Simpson within this HPA.

3.5.4 Plant Species of Concern

The CNDD identified 46 plant species of special concern located within the Primary Assessment Area. An additional 5 plant species of concern were identified as potentially occurring in the rain-on-snow areas outside of the Primary Assessment Area. Of the 51 plant species of special concern, 4 are federally and / or state-listed as endangered, including Humboldt milk-vetch (*Astragalus agnicidus*), Kneeland prairie pennycress (*Thlaspi californicum*), McDonald's rock cress (*Arabis macdonaldiana*), and western lily (*Lilium occidentale*). An additional 11 plant species considered federal species of concern were initially identified as having the potential to occur on Simpson property based on habitat associations and distribution.

The habitat association and distribution of the 51 special-status plant species are summarized in Table 3.5-3 below. The habitat requirements, occurrence and distribution, and life history characteristics of the 4 listed species and 11 federal species of concern that potentially occur within the Primary Assessment Area and / or Simpson ownership in rain-on-snow area outside the Primary Assessment Area are described below.

Plant descriptions for the 4 listed species and 11 federal species of concern are from the 1992 Simpson NSOHCP and the July 2000 CNPS rare plant database. References include Hickman, 1993; Skinner and Palik, 1994; Abrams, 1923, 1944, 1951; and Munz and Keck, 1970 (citations and CNPS Codes provided below).

3.5.4.1 Bensoniella *(Bensoniella oregona)*

Bensoniella is an evergreen perennial herb that blooms in July. The plants occur in the Klamath Mountains of northwestern California and southwestern Oregon. Habitats include streams, meadow edges, and openings in low montane mixed evergreen and white fir forests, from 3,000 to 5,000 feet in elevation. Thought to be extinct, the species was observed in Humboldt County in 1977 and numerous populations have subsequently been identified. Bensoniella sites have been impacted from grazing and logging activities such as road construction, tree removal, and increased sedimentation. Although currently not listed by the State of California or the federal government, bensoniella is a USFWS species of special concern. There are currently two known occurrences in the general area at Mad River Buttes and Maple Creek.

3.5.4.2 Howell's Montia (*Montia howellii*)

Howell's montia is a perennial herb blooming from March to May. The current range of this species is limited to northern California, western Oregon, Washington, and British Columbia. Habitat includes wet disturbed areas around meadows, vernal pools, and moist shady places in redwood forests generally occurring at elevations less than 1,300 feet. Road construction and tree removal are potential threats to this species. The species was presumed to have gone extinct in California (CNPS 1A), but numerous sitings of this species have recently occurred in isolated areas within the Coastal Lagoons Hydrographic Region (O'Dell, personal communication, August 15, 2001). This species is a USFWS species of special concern. The two CNDD recorded occurrences in the area, at Miranda and Bridgeville, are both extirpated.

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
American Manna Grass *Glycera grandis*	--	--	2	Wet meadows, ditches, streams, ponds	Moderate potential for occurrence, some habitat present	4,8,9	No records
Arctic starflower *Trientalis arctica*	--	--	2	Meadows, seeps, bogs, fens	Low due to limited habitat availability	1 **	No records
Bensoniella *Bensoniella oregona*	FSC	--	1B	Stream banks, meadows, bogs, fens lower montane coniferous forest	Moderate potential for occurrence, some habitat present. No specimens found during THP surveys	4,8,9,11	No records
Black crowberry *Empetrum nigrum ssp. hermaphroditum*	--	--	2	Coastal bluff scrub, coastal prairie	Moderate potential for occurrence, some habitat present	1,6 **	No records
Bog club moss *Lycopodiella inundata*	--	--	2	Bogs, fens, marshes, swamps, lower montane coniferous forests	Moderate potential for occurrence, some habitat present	6,7	No records
Coast checkerbloom *Sidalcea oregana ssp. eximia*	--	--	1B	Endemic to Humboldt County. Gravely soils in meadows and seeps. North coast coniferous and lower montane coniferous forests	Moderate potential for occurrence, some habitat present	1,4,7,8,9,10	USGS Quad: Hyampom
Coast Range lomatium *Lomatium martindalei*	--	--	2	Lower montane coniferous forests, coastal bluffs, meadows	Moderate potential for occurrence, some habitat present	1,3	No records
Dwarf alkali grass *Puccinellia pumila*	--	--	2	Mineral springs and coastal salt marshes	Low, limited habitat in study area	8,10	No records

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	**Alt. C Extended Area Only**
English peak greenbriar *Smilax jamesii*	--	--	1B	Marshes, lakes, swamps and streams in lower montane coniferous forests and north coast coniferous forests	Moderate potential for occurrence, some habitat present	3	No records
Fiberous pondweed *Potamogeton foliosus var. fibrillosus*	--	--	2	Marshes, ponds, small streams	Moderate potential for occurrence, some habitat present	1 **	No records
Flaccid sedge *Carex leptalea*	--	--	2	Meadows, bogs, fens, marshes and swamps	Moderate potential for occurrence, some habitat present	1,2,4,6,7,8,10	No records
Great Burnet *Sanguisorba officinalis*	--	--	2	Marshes, swamps, bogs, fens, seeps, riparian areas, meadows, broad-leaved upland forest, north coast coniferous forest	Moderate potential for occurrence, some habitat present	4,8,9,11	No records
Henderson's fawn lily *Erthronium hendersonii*	--	--	2	Lower montane coniferous forests	Good potential for occurrence	1	No records
Horned butterwort *Pinguicula vulgaris ssp. macroceras*	--	--	2	Bogs, fens, meadows, seeps, associated with serpentine	Moderate potential for occurrence, some habitat present	1	USGS Quad: Broken Rib Mt.*
Howell's jewel flower *Streptanthus howellii*	--	--	1B	Lower montane coniferous forests, associated with serpentine	Moderate potential for occurrence, some habitat present	1	No records
Howell's montia *Montia howellii*	FSC	--	1A	Vernally wet sites, meadows, northeast coniferous forest	Moderate potential for occurrence, some habitat present	8, 10	USGS Quad: Miranda

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Humboldt milk-vetch *Astragalus agnicidus*	FSC	SE	1B	Broad-leaved upland forest	Moderate potential for occurrence, some habitat present. No specimens found during THP surveys	No records	USGS Quad: Miranda*
Indian pipe *Monotropa uniflora*	--	--	2	Broad-leafed upland forest and north coast coniferous forest, often associated with redwoods and western hemlock	Good potential for occurrence	1, 8	No records
Kneeland prairie pennycress *Thlaspi californicum*	FE	--	1B	Serpentine rock outcrops within coastal prairies	Moderate potential for occurrence, some habitat present	8,10,11	No records
Koehler's stipitate rock cress *Arabis koehleri var.stipitata*	--	--	1B	Lower montane coniferous forests, chaparral, associated with serpentine	Moderate potential for occurrence, some habitat present	1	USGS Quad: Broken Rib Mt.*
Maidenhair spleenwort *Asplenium trichomanes ssp. trichomanes*	--	--	2	Lower montane coniferous forest	Good potential for occurrence	1	No records
Maple leaved checkerbloom *Sidalcea malachroides*	--	--	1B	Coastal woodlands and clearings, often in disturbed areas. Broad-leaved upland forest, coastal prairie, coastal scrub, north coast coniferous forest	Good potential for occurrence; not known on Simpson property	1, 2, 4, 7, 8, 9, 10, 11**	No records
Marsh pea *Lathyrus palustris*	--	--	2	Coastal prairie, coastal scrub, bogs, fens, marshes, swamps, lower montane coniferous forests	Moderate potential for occurrence, some habitat present	1,4,6,8,10**	No records

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Marsh violet *Viola palustris*	--	--	2	Coastal scrub, bogs and fens	Moderate potential for occurrence, some habitat present	1,4,6,8	No records
McDonald's rock cress *Arabis macdonaldiana*	FE	SE	1B	Montane coniferous forests, associated with serpentine	Moderate potential for occurrence, some habitat present	1	USGS Quad: Broken Rib Mt.*
Meadow Sedge *Carex praticola*	--	--	2	Moist to wet meadows	Moderate potential for occurrence, some habitat present	1,4,8,9	No records
Mendocino gentain *Gentiana setigera*	FSC	--	1B	Lower montane coniferous forests, meadows, associated with serpentine	Moderate potential for occurrence, some habitat present	1	No records
Northern microseris *Microseris borealis*	--	--	2	Meadows, bogs, fens, marshes and swamps, lower montane coniferous forests	Moderate potential for occurrence, some habitat present	4,8,9	No records
Nuttall's saxifrage *Saxifraga nuttallii*	--	--	2	North coast coniferous forests	Good potential for occurrence	1	No records
Opposite leaved lewisia *Lewisia oppositifolia*	--	--	1B	Lower montane coniferous forests, sometimes on serpentine	Good potential for occurrence; not known on Simpson property	1	No records
Oregon Fireweed *Epilobium oreganum*	FSC	--	1B	Bogs, fens, meadows, montane coniferous forest	Moderate potential for occurrence, some habitat present; not known on Simpson property	3,4,8,9,11	No records
Oregon lungwort *Mertansia bella*	--	--	2	Meadows, seeps, upper montane coniferous forests	Known only from Siskiyou County	No records	USGS Quad: Broken Rib Mt.*

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Purple stemmed checkerbloom *Sidalcea malvaeflora ssp. patula*	FSC	--	1B	Coastal prairie, broad-leaved upland forest	Moderate potential for occurrence, some habitat present	1,7,8,10,11**	No records
Robust false Lupin *Thermopsis robusta*	--	--	1B	North coast coniferous forest, broad-leaved upland forest	Known to occur on Simpson property (Blue Creek Mt., Johnson)	2,3,4,5,7,8,9**	No records
Robust monardella *Monardella villosa ssp. globosa*	--	--	1B	Chaparral, cis-montane woodlands	Moderate potential for occurrence, some habitat present	10	No records
Running pine *Lycopodium clavatum*	--	--	2	Moist areas in north coast coniferous forest, marshes and swamps. Known in California only from Humboldt County	Moderate potential for occurrence, some habitat present	2,4,5,6,7,8,9, 11**	No records
Sanford's arrowhead *Sagittaria sanfordii*	FSC	--	1B	Marshes, swamps, ponds, ditches	Low due to limited habitat availability	1	No records
Siskiyou Indian paintbrush *Castilleja miniata ssp. elata*	--	--	2	Lower montane coniferous forests, bogs, fens, stream benches, associated with serpentine	Moderate potential for occurrence, some habitat present	1, 3	No records
Siskiyou phacelia *Phacelia leonis*	--	--	1B	Upper montane coniferous forest, meadows and seeps, sometimes on serpentine	Known only from Siskiyou and Trinity Counties	No records	Quad: Broken Rib Mt.*
Small ground cone *Boschniakia hookeri*	--	--	2	North coast coniferous forest	Good potential for occurrence	1,5	No records
Sonoma manzanita *Arctostaphylos canescens ssp. sonomensis*	--	--	1B	Chaparral, lower montane coniferous forest	Good potential for occurrence	4,8,9	No records

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Thurber's reed grass *Calamagrostis crassiglumis*	FSC	--	2	Coastal scrub, freshwater marshes	Moderate potential for occurrence, some habitat present	1 **	No records
Two Flowered Pea *Lathyrus bifolorus*	FSC	--	1B	Serpentine endemic found only in Humboldt County in lower montane coniferous forests	Low due to limited habitat availability	11	No records
Waldo Buckwheat *Erogonum pendulum*	--	--	2	Montane coniferous forests, associated with serpentine	Moderate potential for occurrence, some habitat present	1	No records
Waldo Daisy *Erigonium bloomeri var. nudatus*	--	--	2	Montane coniferous forests, associated with serpentine	Moderate potential for occurrence, some habitat present	No records	Quad: Broken Rib Mt.*
Waldo rock cress *Arabis aculeolata*	--	--	2	Broadleafed upland forest, lower montane coniferous forest, upper montane coniferous forest. Often found in serpentine slopes and ridges	Low potential for occurrence due to limited habitat availability; only 10 known recorded California occurrences in Del Norte and Siskiyou counties	No records	Quad: Broken Rib Mt.*
Water bulrush *Scirpus subterminalis*	--	--	2	Marshes and swamps; montane lake margins, in shallow water	Moderate potential for occurrence, some habitat present	5	Quad: Broken Rib Mt.*
Western Bog Violet *Viola primulifolia ssp. occidentalis*	FSC	--	1B	Bogs, fens, marshes, swamps, streamside flats associated with serpentine	Low potential for occurrence due to limited habitat availability	1	No records
Western lily *Lilium occidentale*	FE	--	1B	Coastal scrub, freshwater marshes, bogs and fens, coastal prairie, north coast coniferous. Forest	Moderate potential for occurrence; some habitat present; no specimens found during THP surveys	1, 8, 10**	No records

TABLE 3.5-3
Plant Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	CNPS	Habitat Associations	Potential for Occurrence in Primary Assessment Area	RAREFIND Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt. C Extended Area Only
Wolf's evening primrose *Oenothera wolfii*	FSC	--	1B	Lower montane coniferous forests, coastal bluff scrub, coastal prairie, dunes	Moderate potential for occurrence, some habitat present	1,2,6,7,10	No records
Yellow-tubered toothwort *Cardamine nuttallii var. gemmata*	FSC	--	1B	Lower montane and north coast coniferous forests associated with serpentine	Moderate potential for occurrence, some habitat present	1	No records

* In rain-on-snow lands of Simpson property outside of HPA coverage
** Range within the Primary Assessment Area extends beyond Simpson ownership

U.S. Fish and Wildlife Service (USFWS) Federal Listing Categories
FE Federal Endangered
FSC Federal Species of Concern

California Department of Fish and Game (CDFG) State Listing Categories
SE California Endangered

California Native Plant Society (CNPS)
CNPS 1A Presumed extinct in California
CNPS 1B Rare, threatened, or endangered in California and elsewhere
CNPS 2 Rare, threatened, or endangered in California, but more common elsewhere

Hydrographic Planning Areas:
Smith River Hydrographic Region - 1
Coastal Klamath Hydrographic Region - 2
Blue Creek Hydrologic Unit - 3
Interior Klamath Hydrographic Region - 4
Redwood Creek Hydrologic Unit - 5
Coastal Lagoons Hydrographic Region - 6
Little River Hydrologic Unit - 7
Mad River Hydrographic Region - 8
North Fork Mad River Hydrologic Unit - 9
Humboldt Bay Hydrographic Region – 10
Eel River Hydrographic Region - 11

by the state of California and is a USFWS species of special concern. No specimens have been observed on Simpson property.

3.5.4.4 Kneeland Prairie Penny Cress (*Thlapsi californicum*)

Kneeland Prairie Penny Cress is a perennial herb that flowers from April to July. A single occurrence of this species in known from Humboldt County, California. Historically, it is presumed to have been found on serpentine rock outcrops within coastal prairies at elevations of 400 to 1,200 feet. The current population could be potentially threatened by road maintenance activities, but is protected by the landowner. The effects of timber activities are unknown. This species is currently listed as endangered by the federal government. No specimens have been observed on Simpson property.

3.5.4.5 Macdonald's Rock Cress (*Arabis macdonaldiana*)

Macdonald's rock cress is a perennial herb that flowers from May to early June. It is known to occur in Curry County, Oregon, and Del Norte and Mendocino counties in California. Only the two populations from Red Mountain are recognized as unhybridized strains. The plant occurs on serpentine soils in open, rocky areas of montane conifer forests at elevations around 4,000 feet. Existing threats to the population are from strip mining activities. The potential impacts of timber activities are unknown. The species is currently listed as endangered by the federal government and the State of California. No specimens have been observed on Simpson property.

3.5.4.6 Mendocino Gentian (*Gentiana setigera*)

Mendocino gentian is a perennial herb blooming from August to September. Distribution ranges from the Klamath mountains in southwestern Oregon to the outer north coast rages in the locale of Red Mountain, Mendocino County, to western Siskiyou County in California. Habitats include wet meadows, seeps, bogs, streamsides, and moist areas associated with Port Orford, Jeffrey pine, western white pine, and red fir forests from 3,500 to 6,500 feet in elevation. Mining activities and wetland alteration are known to impact this species. Logging activities such as road construction and tree removal are potential impacts on the species. Mendocino gentian is a USFWS species of special concern. There are no known occurrences in the general area.

3.5.4.7 Oregon Fireweed (*Epilobium oreganum*)

Oregon fireweed is a perennial herb that blooms from June to August. Distribution ranges from the north coast range of California through the Klamath Mountains region of southwestern Oregon. Habitats include mesic sites in conifer forests, small streams, ditches, bogs, and fens between 1,600 and 5,200 feet in elevation. This species is known to be impacted by logging activity. Although currently not listed by the State of California or the federal government, Oregon fireweed is a USFWS species of special concern. There are several known occurrences within the general area: Sims Mountain, Broad Camp Mountain, Willow Creek, and Grouse Mountain.

3.5.4.8 Purple-Stemmed Checkerbloom (*Sidalcea malviflora ssp. patula*)

This perennial herb of the mallow family is found in coastal prairies and broad-leaved upland forests. It blooms from March to June and is recognized by its pink flowers. It is presumed to be extant. Although currently not listed by the State of California or the federal government, the purple-stemmed checkerbloom is a USFWS species of special concern.

3.5.4.9 Sanford's Arrowhead (*Sagittaria sanfordii*)

Sanford's arrowhead is an emergent perennial herb blooming from May to August. Distribution ranges throughout much of the California coast range form Del Norte County to northern Ventura County. Habitats include freshwater marshes, swamps, ponds, ditches, sloughs, and slow moving waterways generally below 1,000 feet in elevation. The greatest impacts on this species have been from grazing, channel alteration, and development. Logging activities such as road construction and tree removal have potential impacts on the species. Although currently not listed by the State of California or the federal government, Sanford's arrowhead is a USFWS species of special concern. It is known to occur in the Crescent City area.

3.5.4.10 Thurber's Reed Grass (*Calamogrostis crassiglumis*)

Thurber's reed grass is an evergreen perennial herb that blooms from June to July. Its range includes the central and northern coast ranges of California. Habitats include moist areas within coastal scrub, freshwater marshes, and swamps. Grazing and direct physical impacts from logging activities such as road construction and tree removal are potential threats to this species. Thurber's reed grass is a USFWS species of special concern. This plant is known to occur in the Crescent City area.

3.5.4.11 Two Flowered Pea (*Lathtrus biflorus*)

This is a small perennial herb in the legume family. This minute plant rarely exceeds heights of 2 inches and is easily identified by its unbranched, straight, bristle-like tendrils occurring at the ends of the compound leaves. The greenish-white flowers occur in pairs, hence the name two flowered pea, bloom from May through July and have distinctive dark striations. Endemic to California, the two flowered pea occurs in the north coast mountains and is generally associated with high-elevation (4,500 ft) Jeffery pine forests on serpentine substrates. Occurrence is restricted to a few small populations and the species is considered to be endangered throughout its range. Although currently not listed by the State of California or the federal government, the two flowered pea is a USFWS species of special concern.

3.5.4.12 Western Bog Violet (*Viola primulifolia ssp. occidentalis*)

Western bog violet is a perennial herb blooming from April to September. The range is from the northern part of Del Norte County, near Gasquet, to southwestern Oregon. Habitats include bogs, marshes, fens, and swamps on serpentine soils or in mixed conifer forests below 2,500 feet in elevation. Mining, logging, road construction, and off-road vehicles are known to impact this species. Potential impacts in the area could result from road building and timber removal. Although currently not listed by the State of California or the federal government, the western bog violet is a USFWS species of special concern. There are no known occurrences in the general area.

3.5.4.13 Western Lily (*Lilium occidentale*)

Western lily is a seasonal perennial herb blooming from June to July. Its range extends from coastal southwestern Oregon to Humboldt County, California. Habitats include coastal scrub and prairie, freshwater marshes, and coniferous forest openings, generally at elevations less than 300 feet. Habitat loss, grazing and over-collection of bulbs pose the greatest threats to this species. Potential impacts in the area could result from road building and timber removal. The western lily is currently listed as endangered by the federal government. This species in known to occur at Fields Landing, Arcata, and Crescent City.

3.5.4.14 Wolf's Evening Primrose (*Oenothera wolfii*)

Wolf's evening primrose is a seasonal perennial herb that blooms from May to October. Range includes the northern coastal areas and the western Klamath Mountains in Humboldt and Del Norte counties. Habitats include coastal bluff scrub, coastal prairie, moist areas in coastal dunes, moist areas in lower montane mixed conifer forest types, and roadsides less than 300 feet in elevation. Known impacts include road maintenance, foot traffic, and hybridization with non-native species. Potential impacts in the area could result from road building and timber removal. Although currently not listed by the State of California or the federal government, Wolf's evening primrose is a USFWS species of special concern. There are several known occurrences in the general area: Crannell, Regua, Smith River, and Crescent City.

3.5.4.15 Yellow-Tubered Toothwort (*Cardamine nuttallii var. gemmata*)

Yellow-tubered toothwort is a seasonal perennial herb that blooms from April to May. This species in known from fewer than 10 occurrences from the Klamath-Siskiyou Mountains of southwestern Oregon and in Del Norte County, California. Habitats include moist associated Jeffrey pine forests on serpentine, yellow pine, mixed conifer, and redwood forests, as well as stream banks and shallow running water at elevations ranging between 300 and 3,000 feet. Mining activities are known to impact this species and road building and timber removal are likely to impact the species in the area. Although currently not listed by the State of California or the federal government, the yellow-tubered toothwort is a USFWS species of special concern. Currently there is one known occurrence in the general area at High Divide.

3.6 Terrestrial Habitat/Wildlife Species of Concern

3.6.1 Study Methodology

This chapter of the EIS relies on data made available from Simpson, the CNDD, CDFG, and USFWS. This chapter describes wildlife contained within the Primary Assessment Area for the Proposed Action and other action alternatives, as well as for the entire Simpson ownership in northern California. Vegetation was grouped into habitat type classifications as described in Section 3.5.1. Known or potential wildlife use within these defined habitat types was then described primarily using the CWHR system (Mayer and Laudenslayer 1988) and CNDD.

Rare wildlife species were identified using a July 2000 query of the CNDD for all USGS quadrangles occurring within the Primary Assessment Area and within Simpson ownership outside of the HPAs. This information was loaded into an Access database to sort information by species, HPA, and USGS quadrangle; therefore, if a species is identified as occurring within the Primary Assessment Area within a particular HPA, it implies that the species is located within a topographic quadrangle occurring within the Primary Assessment Area. It is possible that the actual species record location is outside of Primary Assessment Area boundaries.

3.6.2 CWHR Habitat Characterizations

3.6.2.1 Klamath Mixed Conifer

Numerous small meadows and seeps found throughout this habitat type and the high diversity of vegetation make this an excellent habitat for wildlife, including several rare and endangered species, such as the northern spotted owl and peregrine falcon.

3.6.2.2 Douglas-Fir

The Douglas-fir habitat occurs within a matrix of habitat types and supports a high diversity of wildlife species. Common bird species include northern spotted owl, western flycatcher, chestnut-backed chickadee, golden-crowned kinglet, Hutton’s vireo, solitary vireo, hermit warbler, and the varied thrush. Several rare and endangered amphibians are also found associated with this habitat type, including Pacific giant salamander, Olympic salamander, Del Norte salamander, black salamander, clouded salamander, tailed frog, and northwestern garter snake. Mammal species typically associated with this habitat are fisher, deer mouse, dusky-footed woodrat, western red-backed vole, Douglas’ squirrel, Trowbridge’s shrew, and shrew-mole.

3.6.2.3 Redwood

The redwood habitat type supports a high diversity of wildlife species. Nearly 200 species of wildlife use redwoods for food, cover, and other habitat needs. The canopy supports western flycatcher, Steller’s jay, chestnut-backed chickadee, golden-crowned kinglet, Vaux’s swift, raven, and varied thrush. The trunks attract pygmy nuthatches, hairy woodpeckers, northern spotted owls, northern flying squirrels, and Douglas’ squirrels. The branches provide suitable nesting habitat for marbled murrelet and red tree vole. On the forest floor, one finds blue grouse, Townsend’s chipmunks, Trowbridge’s and Pacific shrews, elk, mule deer, salamanders, and wrens. Redwoods support other sensitive, rare, and endangered species, such as red-legged frog, ensatina, osprey, ringtail, fisher, and peregrine falcon.

3.6.2.4 Montane Hardwood

Bird and animal species characteristic of this habitat type include disseminators of acorns (scrub and Steller’s jays, acorn woodpecker, and western gray squirrel) plus those that use acorns as a major food source, including wild turkey, mountain quail, band-tailed pigeon, California ground squirrel, dusky-footed woodrat, black bear, and mule deer. Deer also use the foliage of several hardwoods. Many amphibians and reptiles are found on the forest floor of this habitat. Among them are Mount Lyell salamander, ensatina, relictual slender salamander, western fence lizards, and sagebrush lizard. Snakes include rubber boa, western rattlesnake, California mountain king snake, and sharp-tailed snake.

3.6.2.5 Montane Hardwood-Conifer

The diversity of vegetation within this habitat type is excellent for wildlife. Older trees and snags provide important habitat for cavity nesters, and many of the hardwoods are masting species characterized by periodic prolific seed production which provide food resources for birds and mammals.

3.6.2.6 Perennial Grassland

Grasslands provide important habitat for numerous wildlife species, including the peregrine falcon, burrowing owl, northern harrier, California vole, Roosevelt elk, and black-tailed deer.

3.6.2.7 Wet Meadows

Wet meadows provide important habitat for numerous bird species, including waterfowl, as well as mammals, such as mule deer and elk. Species that may be found in this habitat type include foothill yellow-legged frog, northern harrier, merlin, sharp-shinned hawk, northern goshawk, and ensatina.

3.6.2.8 Lacustrine

According to Mayer and Laudenslayer (1988), the Lacustrine habitat type supports about 23 percent of the species in the CWHR database, including 18 mammals, 101 birds, 9 reptiles, and 22 amphibians.

3.6.2.9 Riverine

The open water zones of large rivers provide resting and escape cover for many species of waterfowl. The open water area also provides good hunting ground for gulls, terns, osprey, and bald eagle. Near-shore waters provide food for waterfowl, herons, shorebirds, belted-kingfisher, and American dipper. Many insect-eating birds are also commonly found along waterways, including swallows, swifts, and flycatchers. Small mammals commonly found in this habitat type include river otter, mink, muskrat, and beaver.

3.6.3 Wildlife Species of Concern

A July 2000 query of the CNDD identified 28 wildlife species (excluding fish) of special concern located on commercial timberlands within USGS quadrangles encompassing the Primary Assessment Area within the 11 HPAs and the rain-on-snow areas under Alternative C. As a result of discussions among the USFWS, CDFG, and Simpson, another 20 wildlife species were added to the sensitive wildlife species list developed for purposes of this EIS. Of the 48 sensitive wildlife species identified, 8 species are federally or state listed: American peregrine falcon, bald eagle, bank swallow, little willow flycatcher, marbled murrelet, northern spotted owl, western snowy plover, and Oregon silverspot butterfly. Seven of these eight species are known or thought to occur within the Primary Assessment Area. There is no suitable habitat for the western snowy plover on commercial timberlands constituting the Primary Assessment Area.

In addition to the federally or state listed species noted above, there are 11 wildlife species identified as federal species of concern that are known to occur or potentially occur within the Primary Assessment Area. The habitat association and distribution of the 48 special-status wildlife species are summarized in Table 3.6-1 below. The habitat requirements, occurrence and distribution, and life history characteristics of the seven federally or state listed species that potentially occur within the Primary Assessment Area are described below.

3.6.3.1 American Peregrine Falcon (*Falco peregrinus anatum*)

Breeding territory typically includes the inland coastal mountains and the Klamath, Cascade, and Sierra Nevada mountain ranges. Breeding sites are generally on high cliffs near wetlands, lakes, and rivers or other sources of water. The peregrine falcon preys mainly on birds, striking with its feet in mid air, but will also take reptiles and small mammals. Perching sites and abundance of prey are important habitat characteristics. Use of pesticides has been cited as the main reason for the peregrine's decline in population; however, habitat modification also impacts this species.

Some habitat for this species is present within the lakes or ponds of the Redwood Creek Hydrologic Unit and the HPAs where Riverine habitat is found. Two currently known active nest sites and one historical nest site exist on the Simpson ownership. Two additional historically active nest sites are located on other ownerships immediately adjacent to Simpson lands.

3.6.3.2 Bald Eagle (*Haliaeetus leucocephalus*)

Western breeding and wintering territory includes the Pacific Coast from Alaska to Baja California. Ocean shorelines, lake margins, and river courses in northwestern California provide essential breeding areas. Nesting sites are typically associated with large old-growth, or forests with open-branched canopies such as ponderosa pines. Bald eagles roost communally during the winter. Pesticides, habitat loss, and human disturbances are the primary threats to this species.

A nesting pair of bald eagles has been observed along the Mad River on the Simpson ownership.

3.6.3.3 Bank Swallow (*Riparia riparia*)

The bank swallow breeds across North America from Alaska to California, but it winters in the tropics. They breed in colonies near riverbanks and creeks. This species requires vertical banks or cliffs with fine-textured soils to dig nesting holes. Most birds lay their eggs and forage for their young at the same time.

Some habitat for this species is present in HPAs where Riverine habitat is found.

3.6.3.4 Marbled Murrelet (*Brachyramphus marmoratus*)

This species is found along the north Pacific Rim from Asia to North America. Breeding populations in northern California are divided into two regions: (1) Del Norte and northern Humboldt counties, from the Smith River south to Little River; and (2) south–central Humboldt County along the Van Duzen and Eel rivers. Marbled murrelets are considered to have highly plastic nesting requirements and have been known to use tree branches, ground cavities, and open ground sites in alpine areas. Old-growth redwood forests with open crown structures and an open canopy stand appear to be favored nesting habitats. Extensive loss of this old-growth habitat is presumably the primary reason for the species decline in

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Birds							
American peregrine falcon *Falco peregrinus*	FE	CE	BFS	Breeds on high cliffs near wetlands, lakes and rivers	Moderate potential for occurrence, some habitat present; infrequently observed.	Coastal lowlands near Humboldt Bay, USGS Quad: Miranda	USGS Quad: Miranda
Bald eagle *Haliaeetus leucocephalus*	FT	CE	BFS	Nests in large old growth, trees near ocean shore, lakes and rivers	Regular winter inhabitant; two nest sites known in ownership (Mad River and Klamath River; moderate potential for occurrence in other areas; some habitat present).	1, 2, 3, 4, 8, 9, 11	USGS Quads: Hennessy Peak, Sportshaven
Bank swallow *Riparia riparia*	-----	CT	-----	Colonial nester in riparian area with vertical sandy banks composed of fine soils	Moderate potential for occurrence, some habitat present; none observed.	1,6,7	No record
Black swift *Cypseloides niger*	-----	CSC	-----	Breeds in small colonies adjacent to waterfalls in deep canyons and coastal bluffs, forages widely	Low potential for occurrence due to limited habitat availability.	1	No record
Black-crowned night heron *Nycticorax nycticorax*	-----	-----	-----	Margins of lacustrine, large riverine, and fresh and saline emergent habitats	Moderate potential for occurrence, some habitat present.	4,7,8,9,10	No record
Coopers hawk *Accipiter cooperii*	-----	CSC	-----	Open woodlands, nests in riparian areas	Known to occur on Simpson property (Maple Creek); appear to be ubiquitous. Moderate potential for occurrence in other areas.	4,8,9	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Golden eagle *Aquila chrysaetos*	-----	CSC	BFS	Rolling foothills and open mountain terrain in oak woodlands and most major forested habitats.	Occasionally seen in the open woodlands of the eastern portion of the Simpson ownership, but no nests documented. Low potential for occurrence in other areas.	Infrequent observations, open areas in the interior regions of ownership	USGS Quad: Miranda
Great blue heron *Ardea herodias*	-----	-----	BFS	Wet meadows, marshes, lake margins, rivers and streams and tidal flats	Foraging known to occur on Simpson property (Hydesville, Fortuna). One rookery known near Eel River. Moderate potential for occurrence in other areas.	1,2,3,5,7,8,10	No record
Great egret *Ardea alba*	-----	-----	BFS	Colonial nester in large trees near marshes, tidal flats, rivers and lakes	Moderate potential for occurrence, some habitat present. Foraging only.	1, 8, 10	No record
Little willow flycatcher *Empidonax trailii brewsteri*	-----	CE		Riparian areas with extensive willow vegetation	One breeding site known in the Klamath region. Low potential for occurrence in other areas.	No record	No Record
Marbled murrelet *Brachyramphys marmoratus*	FT	CE		Late seral conifer forest and marine waters	Known to occur in a number of residual old-growth stands in the Klamath region and one-second growth stand with residual structure in the Little River drainage. Low potential for occurrence in other areas.	2,4,7	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Merlin *Falco columbarius*	-----	CSC		Frequents coastlines, open grassland, woodlands, lakes, wetlands, edges and early successional forest stages	Low potential for occurrence. Not seen except for coastal bottoms in winter. Probably do not occur within ownership.	No record	No record
Northern harrier *Circus cyaneus*	-----	CSC		Open habitats including grasslands, scrublands, and wetlands	Moderate potential for occurrence. Observed in non-forested areas of ownership.	No record	No record
Northern goshawk *Accipiter gentilis*	-----	CSC	BFS	Nests on northern slopes in coniferous forests	Low potential for occurrence; rare or absent from Simpson ownership.	11**	USGS Quad: Hennessy Peak
Northern spotted owl *Strix occidentalis caurina*	FT	CSC	BFS	Old growth or mixed mature-old growth forests	Moderate potential for occurrence. Known to occupy and reproduce on the Simpson ownership.	All planning areas**	USGS Quads: Broken Rib Mountain, Hennessy Peak, Sportshaven, Hyampom
Olive-sided flycatcher *Contopus borealis*	FSC	-----		Forest and woodland riparian zones	Moderate potential for occurrence. Commonly seen throughout the Simpson ownership; confirmed nest sites.	No record	No record
Osprey *Pandion haliaetus*	-----	CSC	BFS	Freshwater lakes, bays, ocean shore, large streams	Known to occupy and reproduce within Simpson property (Ah Pah Ridge, Arcata South, Fields Landing, McWhinney Creek, Requa). Moderate potential for occurrence in other areas.	All planning areas except Eel River**	USGS Quads: Hennessy Peak, Myers Flat, Miranda

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Purple martin *Progne subis*	-----	CSC		Forest and woodland with cavity trees and riparian zones	Occasionally seen throughout the ownership and several nest sites known in Korbel tract. Moderate potential for occurrence in other areas.	No record	No record
Sharp-shinned hawk *Accipiter striatus*	-----	CSC		Early to mid seral forest and riparian zones. Frequently seen throughout ownership, but specific nest sites have not been confirmed	Moderate potential for occurrence. Ubiquitous throughout the ownership. Nest sites observed in older 2nd growth stands.	No record	No record
Short-eared owl *Asio flammeus*	FSC	CSC		Marshlands, grasslands, and forest clearings	Moderate potential for occurrence. Seen at several sites throughout the ownership, but no known breeding sites.	No record	No record
Snowy egret *Egretta thula*	-----	-----	-----	Riverine, emergent wetland, lacustrine, and estuarine habitats. Nests in large trees in the vicinity of foraging areas.	Low potential for occurrence due to limited habitat availability.	1,8,10	No record
Tricolored blackbird *Agelaius tricolor*	-----	CSC	-----	Highly colonial species, largely endemic to California. Requires open water with protected areas for nesting	Moderate potential for occurrence, most numerous in the Central Valley.	10	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Vaux's swift *Chaetura vauxi*	-----	CSC		Conifer forest with large snags	Moderate potential for occurrence. Frequently observed flying over Simpson's timberlands; no nest sites documented.	No record	No record
Western burrowing owl *Athene cunicularia*	FSC	CSC		Grasslands and shrublands	Low potential for occurrence, limited habitat present. Seen in winter at the old office site in the Arcata “bottoms”, and along the Bald Hill Road. No known breeding sites.	No record	No record
Western snowy plover *Charadrius alexandrinus nivosus*	FT	CSC	-----	Sandy beaches, salt ponds and levees, gravel bars along coastal rivers	None, no suitable habitat in the area.	No record	No record
White tailed kite *Elanus leucurus*	-----	-----	-----	Nests along rivers and marshes associated with oak woodlands in foothills and valley margins, forages in open meadows and grasslands	Moderate potential for occurrence, some habitat present.	1	No record
Yellow warbler *Dendroica petechia brewsteri*	-----	CSC		Riparian woodland	Moderate potential for occurrence. Seen commonly throughout Simpson’s ownership, but no work done to confirm nest sites.	No record	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Yellow-breasted chat *Icteria virens*	-----	CSC		Riparian thickets and early seral forest	Low potential for occurrence, some habitat present. Rare occurrences in the Mad River area in 1996.	No record	No record
Mammals							
Fringed myotis *Myotis thysanodes*	FSC	-----		Roosts in mines, caves, trees, and buildings; feeds along forest edges and over forest canopy	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record
Humboldt marten *Martes americana humboldtensis*	FSC	CSC		Late seral conifer forest	Low potential for occurrence, some habitat present. Never been detected on Simpson lands. Martens detected close to the ownership in the Goose Creek drainage (tributary of the South Fork Smith River).	No record	No record
Long-legged myotis *Myotis volans*	FSC	-----		Roosts in hollow trees, crevices, mines, and buildings; feeds in open habitats	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record
Long-eared myotis *Myotis evotis*	FSC	-----		Roosts in trees, crevices, mines, caves and buildings; feeds within forest, and over water	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Pacific fisher *Martes pennanti pacifica*	-----	CSC	-----	Coniferous forests and shaded riparian areas	Known to occur on Simpson property at high elevations not dominated by redwoods (Ah Pah Ridge, Blue Lake, Holter Ridge, Klamath Glen, Lord Ellis Summit, Panther Creek). Moderate potential for occurrence in other areas.	All planning areas except Humboldt Bay**	USGS Quads: Broken Rib Mountain, Hennessy Peak, Myers Flat, Miranda, Sportshaven, Hyampom
Pallid bat *Antrozous pallidus*		CSC		Roosts in trees, caves, crevices, and buildings; feeds in a variety of open habitats	Moderate potential for occurrence. Occurs throughout the region, roosting sites include trees, caves and rock crevices.	No record	No record
Red tree vole *Arborimus pomo*	-----	CSC	-----	Douglas fir, redwood and montane conifer-hardwood forests	Moderate potential for occurrence. Known to occur within ownership near Bald Hill.	All planning areas**	No record
Townsend's western big-eared bat *Corynorhinus townsendii*	-----	CSC	-----	Humid coastal regions of central and northern California, southern Oregon	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record
White footed vole *Arborimus albipes*	-----	CSC	-----	Mature conifer forests, small streams with dense alder and shrub cover	Low potential for occurrence. Presumed rare within the ownership, but their presence has not been confirmed.	6	No record

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Yuma myotis *Myotis evotis*	FSC	-----		Roosts in buildings, trees, mines, caves, crevices, and bridges; feeds over water	Moderate potential for occurrence. Presumed to occur within the ownership, but their presence has not been confirmed.	No record	No record
Reptiles and Amphibians							
Del Norte Salamander *Plethodon elongatus*	-----	CSC	-----	Old growth mixed conifer-hardwood forests	Known to occur on Simpson property, (Ah Pah Ridge, Bald Hills, Blue Creek Mt., Blue Lake, Board Camp, Childs Hill, Fern Canyon, French Camp ridge, Holter Ridge, Iaqua, Johnson, Klamath Glen, Korbel, Panther Creek, Requa). Moderate potential for occurrence in other areas.	All planning areas**	USGS Quads: Broken Rib Mountain, Hennessy Peak
Tailed frog *Ascaphus truei*	-----	CSC	-----	Permanent streams in montane conifer-hardwood, redwood, Douglas fir, and ponderosa pine forests	Known to occur on Simpson property (Ah Pah Ridge, Arcata South, Blue Lake, Childs Hill, Fields Landing, Grouse Mt., Holter Ridge, Korbel, Maple Creek, McWhinney Creek). Moderate potential for occurrence in other areas.	All planning areas**	USGS Quads: Broken Rib Mountain, Sportshaven

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Southern torrent salamander *Rhyacotriton variegatus*	-----	CSC	-----	Permanent streams in coastal redwood, Douglas fir, mixed conifer, montane hardwood, and montane riparian forests	Known to occur on Simpson property (Ah Pah Ridge, Arcata South, Blue Creek Mt., Blue Lake, Can't Hook Mt., Childs Hill, French Camp Ridge, Grouse Mt., Holter Ridge, Iaqua, Johnson, Klamath Glen, Lord Ellis Summit, Mad River Buttes, Maple Creek, Panther Creek). Good potential for occurrence in other areas.	All planning areas**	USGS Quads: Broken Rib Mountain, Hennessy Peak, Sportshaven, Hyampom
Northern red-legged frog *Rana aurora aurora*	-----	CSC	-----	Humid forests with intermixed hardwoods and grasslands, streamsides	Known to occur on Simpson property (Arcata North, Blue Lake, Fields Landing, Iaqua, Lord Ellis Summit). Moderate potential for occurrence in other areas.	All planning areas except Blue Creek and Eel River**	No record
Foothill yellow legged frog *Rana boylii*	-----	CSC	-----	Partly shaded shallow streams with rocky substrate, in a variety of habitats	Good potential for occurrence. Known to occur on Simpson property (Holter Ridge) along most Class I and some Class II streams.	1,2,4,5, 8, 9,10, 11**	USGS Quads: Broken Rib Mountain, Hennessy Peak
Northwestern pond turtle *Clemmys marmorata marmorata*	-----	CSC	-----	Ponds and swamps in grasslands, and mixed conifer-hardwood forests	Good potential for occurrence. Known Mad River, Lower Klamath, and Redwood Creek areas.	4,7,8,9,10,11	USGS Quad: Hennessy Peak, Myers Flat, Sportshaven, Hyampom

TABLE 3.6-1
Wildlife Species of Special Concern Potentially Occurring Within the Simpson Ownership and Primary Assessment Area

Species	USFWS	CDFG	BOF	Habitat Associations	Potential for Occurrence in Primary Assessment Area	CNDD Record Locations (by Hydrographic Planning Area)	
						Primary Assessment Area	Alt C Extended Area Only
Invertebrates							
Ground beetle *Scaphinotus behrensi*	FSC	CSC		Wooded areas with moist microhabitats, including logs and tree trunks	Moderate potential for occurrence, some habitat present.	No record	No record
Pomo bronze shoulderband snail *Helminthoglypta arrosa pomoensis*	FSC	-----		Dense redwood forest	Unknown.	No record	No record
Oregon silverspot butterfly *Speyeria zerene hippolyta*	FT	-----		Coastal meadows in Del Norte County. The larvae feed only on the foliage of the western dog violet (*Viola adunca*)	Low potential for occurrence. 1990 recorded site in Kamph Memorial Park(near Hwy 1 and mouth of Smith River), outside Primary Assessment Area. Large population known in the vicinity of Lake Earl.	1	No record
Karok Indian Snail *Vespericola karokorum*	FSC	-----	-----	Under leaf litter and woody debris in riparian areas with alder and maple	Moderate potential for occurrence, some habitat present.	3	No record

* In rain on snow lands of Simpson property outside of HPA coverage
** Range within the Primary Assessment Area extends beyond Simpson ownership

U.S. Fish and Wildlife Service (USFWS) Federal Listing Categories
FE Federal Endangered
FT Federal Threatened
FSC Federal Species of Concern

California Department of Fish and Game (CDFG) State Listing Categories
CE California Endangered
CT California Threatened
CSC California Species of Special Concern

California Board of Forestry – Forest Practice Rules
BFS Sensitive Species

Hydrographic Planning Areas:
Smith River Hydrographic Region - 1
Coastal Klamath Hydrographic Region - 2
Blue Creek Hydrologic Unit - 3
Interior Klamath Hydrographic Region - 4
Redwood Creek Hydrologic Unit - 5
Coastal Lagoons Hydrographic Region - 6
Little River Hydrologic Unit - 7
Mad River Hydrographic Region - 8
North Fork Mad River Hydrologic Unit - 9
Humboldt Bay Hydrographic Region – 10
Eel River Hydrographic Region - 11

3.5.4.3 Humboldt Milk Vetch (*Astragalus agnicidus*)

This species was presumed to be extinct until 1987 when a single population was discovered on a private ranch south of Miranda, in Humboldt County, California. The plants occur in disturbed, mixed evergreen forest openings approximately 2,500 feet in elevation. Potential impacts from timber activities are unknown. The species is currently listed as endangered California. This species is known to occur in a number of residual old-growth stands in the Klamath region and one second-growth stand with residual structure in the Little River Hydrologic Unit. Based on survey results and consultations with USFWS, CDFG, and CDF, 20 stands located on Simpson's current fee ownership have been identified as suitable for murrelet nesting based on levels of observed murrelet activity and stand characteristics. Stands are located near Terwer, Hunter, Mynot, Hoppaw, and Wilson Creeks, as well as the coastal area. Only one stand, Big Mynot, showed any direct evidence of murrelet nesting (Simpson, 1998). Simpson survey results suggest that murrelets were not uniformly distributed across the landscape prior to timber harvesting in the region. Areas of optimal habitat were probably confined along major drainages. This is consistent with murrelet survey results in large (10,000-acre) stands of old-growth in nearby parks. Murrelet detections were highest in major drainages and declined toward major ridges (Miller and Ralph, 1995).

3.6.3.5 Northern Spotted Owl (*Strix occidentalis caurina*)

This species has a wide range throughout western forests including the Coastal and Klamath Ranges of northern California. Northern spotted owls do not build nests but use naturally occurring sites. They generally nest in cool, shaded areas with a well-developed understory. They prefer natural cavities in large-diameter trees with broken tops. Diverse, multi-layered forests with moderate to high canopy closure (60 percent to 80 percent) and a canopy dominated by large (greater than 30 inches dbh) overstory trees provide optimal habitat conditions. Northern spotted owls have been observed over a wide range of elevations, although they avoid higher elevation, subalpine forests. Breeding and roosting habitat are sometimes found in younger forests, especially those with significant remnants of earlier stands as a result of fire, windstorms, or inefficient logging operations.

With the cooperation of the USFWS, Simpson prepared a separate HCP and obtained an incidental take permit for the species. The plan area for this species covers about 380,000 acres.

3.6.3.6 Little Willow Flycatcher (*Empidonax traillii* ssp. *brewsteri*)

The little willow flycatcher breeds in California from Tulare County north, along the western side of the Sierra Nevada and Cascades, extending to the coast in northern California. The willow flycatcher nests in riparian deciduous shrubs, preferably thickets of willows, at elevations ranging from 100 to 8,000 feet. Foraging typically occurs in wet meadows and montane riparian habitats. Most of the remaining breeding populations occur in isolated mountain meadows of the Sierra Nevada and Cascades, however a possible breeding population occurs along the Klamath River.

3.6.3.7 Oregon Silverspot Butterfly (*Speyeria zerene hippolyta)*

The Oregon Silverspot is found along the coast in northern California and Oregon and requires a meadow species of violet (*Viola adunca*) to complete its development. The Oregon silverspot requires one of three types of grasslands with nearby meadows: coastal salt spray meadows, stabilized dunes, and/or montane meadows, which are surrounded by forests. The grasslands that the Oregon silverspot inhabits provide larval host plants, adult nectar sources, and wind protection. Wind protection is provided by forest fringes around the inhabited meadows. The butterfly may retreat into these forests on especially windy days. A large population of Oregon silverspot butterflies is known from the vicinity of Lake Earl.

3.7 Air Quality

This section describes ambient air quality conditions in a regulatory context, and the potential impacts of the project on air quality issues of concern. General information on climate is described in Section 3.3.3.

The Primary Assessment Area and the additional rain-on-snow acres under Alternative C are located in the North Coast Air Basin, under the authority of the North Coast Unified Air Quality Management District (AQMD). The air quality of a region is determined by the quantities and types of pollutants emitted, and by the concentrations and accumulations of those pollutants under the influences of local meteorology and topography. The North Coast Air Basin is considered to have good air quality.

The Clean Air Act of 1967, as amended in 1990 (42 U.S.C. 7401, et seq.), established national ambient air quality standards for several pollutants, including ozone, carbon monoxide, and particulate matter less than 10 microns in diameter (PM_{10}). In addition, State of California clean air standards have been in existence since 1968. Simpson lands are in attainment for all state and federal air quality standards in Del Norte and Humboldt counties, with the exception of the state standard for PM_{10} (North Coast Unified AQMD, 1997).

Ambient PM_{10} standards are designed to prevent respiratory disease and protect visibility. Suspended particulate matter less than 10 microns in diameter can potentially reach the lungs when inhaled and cause respiratory health concerns. Few particles larger than 10 microns in diameter reach the lungs. In 1993, a chemical mass balance study of PM_{10} was performed by the North Coast Unified AQMD. For this study, 37 samples were collected approximately every 6 days in both Crescent City and Eureka. The results indicated that local PM_{10} originates from various sources, as described in Table 3.7-1.

TABLE 3.7-1
PM_{10} Source Apportionment for Crescent City and Eureka (Yearly Average)

Source	Crescent City (%)	Eureka (%)
Vehicles	23.1	43.7
Sea salts	34.9	24.7
Wood stoves [a]	21.7	12.6
Dust	8.9	6.6
Pulp mills/particle board driers	4.0	5.5

TABLE 3.7-1
PM_{10} Source Apportionment for Crescent City and Eureka (Yearly Average)

Source	Crescent City (%)	Eureka (%)
Nitrates	1.3	1.8
Sulfates	1.7	0.6
Unknown	4.5	4.6
Total	**100**	**100**

[a] In winter months, wood stoves contribute a substantially higher proportion of PM_{10} emissions.
Source: North Coast Unified AQMD, 1994.

Incidence of PM_{10} attributable to timber management is typically a result of slash burning and roadway dust entrainment. The AQMD study did not specifically characterize slash burning as a separate source of PM_{10}. However, PM_{10} attributed to wood stoves likely includes particulate matter resulting from other wood combustion sources (e.g., slash burning) (Torzynski, pers. comm., 2000). Slash burning is controlled by the AQMD through the issuance of burn permits, which include provisions for burn restriction during atmospheric conditions that escalate PM_{10} nonattainment.

3.8 Visual Resources

This section describes areas where the Primary Assessment Area may be visible to the general public, and focuses on adjacent public lands and nearby roadways. The Primary Assessment Area is interspersed among several public recreation areas, including Six Rivers National Forest (including the recreation-oriented Smith River unit) and the Redwood National and State Parks complex. Adjacent lands are described in detail in Section 3.11 (*Land Use*), and recreation use on these adjacent lands is described in Section 3.9 (*Recreational Resources*).

The primary public recreation areas with views of the Primary Assessment Area is Redwood National and State parks. The Primary Assessment Area borders the park in several areas, including most of the Redwood Creek watershed boundary. Limited viewing may also be possible from portions of the Smith River unit of Six Rivers National Forest, and from several park areas in central and southern Humboldt County. However, adjacency to parklands is limited in these areas.

U.S. Highway 101 is the primary roadway in the Primary Assessment Area. Highway 101 is a designated scenic highway in Del Norte County from approximately Crescent City to the south boundary of Del Norte Redwoods State Park, and is considered eligible for scenic highway designation in the remainder of Del Norte and Humboldt counties. All other highways in the vicinity of the Simpson ownership (U.S. Highway 199, U.S. Highway 299, and State Route (SR) 36) are considered eligible for scenic highway designation. Primary areas for viewing the Primary Assessment Area from these highways are as follows.

As Highway 101 proceeds south through Del Norte and Humboldt counties, it is likely that travelers will be able to view Primary Assessment Area in various locations, primarily in the area north of Crescent City, near the Klamath River confluence, and north of McKinleyville. In portions of this area, panoramic views of the Primary Assessment Area are possible from Highway 101, depending on topography in the vicinity. Views of the Primary Assessment

Area from Highway 101 south of Eureka are limited. Highway 299 passes through a portion of the Primary Assessment Area east of Arcata. Views of the Primary Assessment Area from Highway 199 and SR 36 are limited.

3.9 Recreational Resources

Simpson provides recreational opportunities on its forestlands to groups and individuals, subject to written permit authorization. These activities are permitted on a limited basis within specified areas, and include hunting, fishing, camping, picnicking, hiking, motorcycle use, and shooting. The Primary Assessment Area is also adjacent to several national and state parks and recreation areas, as described below and in Section 3.8 (*Visual Resources*).

The Primary Assessment Area is in the vicinity of the Eel, Klamath, and Smith rivers, portions of which are designated Federal Wild and Scenic Rivers. Portions of the Primary Assessment Area may also be viewed from the Smith River National Recreation Area near Jedediah Smith Redwoods State Park. The 300,000-acre Smith River National Recreation Area is a highly-valued recreation area by the USFS and the public. Recreation area users can kayak, canoe, boat, fish, swim, and view wildlife. Smith River National Recreation Area is accessible through a walk-in area off of the main roads. The nearby Six Rivers National Forest is also open to camping and hiking at both developed campsites and undeveloped forest sites by permit.

The Jedediah Smith and Del Norte Coast Redwoods State Parks are jointly managed by the National Park Service and California State Department of Parks and Recreation, and are part of the Redwoods National and State Park. Redwoods National and State Park comprise approximately 110,000 acres, of which a small portion is adjacent to the Primary Assessment Area. In conjunction with another nearby park (Prairie Creek Redwoods), these sites are considered to be “World Heritage Sites” and “International Biosphere Reserves.” Panoramic and close-up views of different tree and vegetation types draw national and international visitors to the parks. The parks allow camping, hiking, horseback riding, and scenic driving.

The Merlo State Recreation Area allows fishing and small boats. The Humboldt Lagoons State Park allows camping and hiking, and fishing at the tide pools. The Humboldt Lagoons State Park is open to boating, fishing, hiking, bird and wildlife viewing, and picnicking. The Headwaters Reserve area encompasses 6,400 acres and is managed jointly by the Bureau of Land Management (BLM) and California Department of Parks and Recreation. Use is limited to day-hiking only. The King Range Landscape Conservation Area encompasses 60,000 acres and is managed by the BLM. The area promotes a variety of uses, including hiking, camping, hunting, and seashore activities.

3.10 Cultural Resources

The earliest inhabitants of the north coast regions were thought to be ancestors of the Karok, which were probably adapted to inland hunting and gathering and arrived sometime around 5,000 years ago (Hildebrant, 1981). Further investigations indicate that exploitation of marine resources apparently was not an important part of the subsistence patterns of the northwest coast until relatively recently. Local tribal groups represented in the Primary Assessment Area include the Tolowa, Yurok, Wiyot, Hupa, Chilula, and Whilkut tribes.

3.10.1 Tolowa

The historical territory of the Tolowa comprised most of present-day Del Norte County, extending from the Winchuck River on the California-Oregon border to Wilson Creek, approximately 17 miles south of Crescent City. Tolowa settlements were strongly oriented toward the coast, with some seasonal occupation along the Smith River drainages to take advantage of particular seasonal resources (Williams et al., 1982). Smelt, salmon, steelhead, and acorns were the staples of their diet, and were gathered, dried, processed, and stored in late summer/early fall in preparation for winter. Berries, shellfish, and sea lions, as well as deer and elk, were also gathered and hunted by the Tolowa (Gould, 1978; Williams et al., 1982).

Traditional areas of sacred and ceremonial importance to Tolowa continue to be used today. Goddard (1913) describes these areas as located near trails, on the crest of ridges, and a few in the neighborhood of springs (Maniery and Williams, 1982). The Tolowa recognized five sacred high points within their territory, including Signal Hill and French Hill. Lesser peaks were also considered to hold healing or spiritual power and were revered (Drucker, 1937).

3.10.2 Yurok

The Yurok historically occupied the lower reach of the Klamath River from approximately Bluff Creek downstream to the river's mouth at Requa, with some settlements along the Trinity River and along the coast primarily south of the Klamath River (Pilling, 1978). The Yurok are recognized for their skills in riverine salmon fishing, and traditional subsistence animal species also include ocean fish, sturgeon, sea lion, whale, deer, elk, and duck. Acorns, berries, bulbs, and grass seed are staple plant foods (Bearss, 1969). Like other North Coast tribes, the Yurok were skilled at basketmaking and woodworking. The Yurok are especially known for their redwood canoes, which were up to 40-feet long. In addition, redwood was used as a building material.

3.10.3 Wiyot

The historical center of Wiyot culture was around Humboldt and Arcata Bays, from Little River south to the Bear River Mountains. The Wiyot were known as a "tidewater" people, and, unlike most other tribes in northwestern California, were probably more closely affiliated with still water than the ocean or rivers (Nomland and Kroeber, 1936). Fish, primarily salmon, were the main source of animal protein, and the Wiyot also consumed mollusks (especially clams), sea lions, and deer and elk, as well as plant foods. Like other cultures in the area, the Wiyot used redwood extensively as a building material.

3.10.4 Hupa, Chilula, and Whilkut

The Hupa inhabited the area surrounding the lower reaches of the Trinity River from approximately Salyer to approximately 6 miles above the confluence with the Klamath River (Wallace, 1978). The Hupa relied heavily on salmon and acorns as food sources, but also consumed other fish (e.g., lampreys), deer, and elk, as well as various plant staples (Wallace, 1978). Like other tribes of the north coast of California, the Hupa were skilled in basketmaking and woodworking, but obtained their dugout redwood canoes in trade with the Yurok (Heizer, 1978; Wallace, 1978).

Chilula territory is closely affiliated with the lower reaches of Redwood Creek in what is now Redwood National Park (Bearss, 1969). Chilula villages were generally located adjacent to Redwood Creek from near the inland edge of the heavy redwood belt to a few miles above Minor Creek (Bearss, 1969). In the summer, the Chilula camped on the highland prairies of the Bald Hills, where seeds and roots were plentiful and game was abundant (Bearss, 1969). At one time, the Chilula were known as the Bald Hill Indians (Wallace, 1978). As with the other tribes of the north coast of California, salmon was a staple of the Chilula diet, and fishing was practiced on Redwood Creek (Wallace, 1978). However, the smaller size of Redwood Creek relative to other watercourses in the area did not support the use of dugout redwood canoes by the Chilula (Wallace, 1978). In terms of their culture, the Chilula were very similar to the Hupa in many ways (Wallace, 1978).

The Whilkut people inhabited the higher reaches of Redwood Creek and the Mad River, including the forested area between the two drainages (Wallace, 1978). Very little is known about the Whilkut people.

3.11 Land Use

3.11.1 Land Use Setting

The Primary Assessment Area is located within Del Norte and Humboldt counties, both of which contain significant amounts of land (both federal and private) in timber production. Del Norte County is 705,920 acres, of which most is under state or federal ownership as parks/recreation areas or national forests (County of Del Norte, 1996). Private commercial forestlands in Del Norte County comprise approximately 146,771 acres, including Simpson fee-owned lands. Humboldt County is 2,286,270 acres is size, with approximately 990,000 acres as private lands devoted to timber production (Humboldt County, 1984).

The Primary Assessment Area in Del Norte County borders a mix of other land uses, primarily other timber production areas and parks/recreation areas. Most of the eastern border of the Primary Assessment Area in Del Norte and Humboldt counties border the Six Rivers National Forest, which is managed by the USFS for multiple uses including timber production and recreation. The Primary Assessment Area also borders the Redwood National and State Parks (Redwood National Park, and Jedediah Smith, Del Norte Coast Redwoods, and Prairie Creek Redwoods State Parks), which are managed jointly by the National Park Service and the California Department of Parks and Recreation. Commercial timber harvesting is not allowed in the parks, and resource preservation and recreation values are the primary management emphases. The Primary Assessment Area also borders the Hoopa Indian Reservation in northeastern Humboldt County. Simpson lands border other industrial and non-industrial forestlands on the east and west throughout central Humboldt County. The western boundary of the Headwaters Reserve, managed by BLM and the California Department of Parks and Recreation, abuts the Primary Assessment Area in central Humboldt County. Other portions of the Primary Assessment Area are generally surrounded by other industrial and non-industrial forestlands.

Developed population centers near the Primary Assessment Area in Del Norte County are generally not present. The primary Humboldt County population center within the vicinity of the Primary Assessment Area is the Eureka / Arcata area. Other towns near the Primary Assessment Area include Fortuna, Rio Dell, and Carlotta.

3.11.2 Land Use Regulations

Local land use regulations that apply to the Primary Assessment Area include the general plans and zoning ordinances of both Del Norte and Humboldt counties. Primary Assessment Area lands are designated as "Forestry" in the Del Norte County General Plan, and as "Timber Production" in the Humboldt County General Plan. These designations are applied to areas that have essential characteristics for timber production, and are intended to conserve forest resource values of the designated area. Most of the Primary Assessment Area is zoned as TPZ. Created in accordance with California's Timberland Productivity Act of 1982, the classification is intended to promote continued timberland management. Land use in a TPZ classification is restricted to growing and harvesting timber, in addition to other compatible uses.

3.12 Social and Economic Conditions

Timber management activities within the Primary Assessment Area and the additional 26,116 rain-on-snow acres under Alternative C can influence local social and economic conditions. For the purposes of this analysis, the geographic area of influence with regard to socioeconomic effects is considered to be Del Norte and Humboldt counties.

3.12.1 Social Factors

As shown in Table 3.12-1, both Del Norte and Humboldt counties have experienced relatively steady population growth over the past decade. During the 1990s, Del Norte County's population grew by 11 percent while Humboldt County grew by 6 percent. These are both slightly less than the state's growth rate over the same period of 13 percent. Because of the rural character of the two counties, the lifestyles of its residents are closely tied to the land. In the EIS for the Six Rivers National Forest Management Plan (USFS, 1995), four social groups were identified based on values and behaviors relating to natural resource management. Members of the "amenity emphasis" and "environmental priority" groups place a high value on maintaining the natural resources of the region, although for different personal and ideological reasons. "Commodity dependent" residents are economically linked to the utilization of natural resources, and are very closely tied to their resource-based lifestyle. The "Native American" group is linked to the biological resources of the forest area for cultural and social reasons, including subsistence and commercial fishing. Members of the "Native American" group may also be employed in the forest products sector and thus are economically dependent on the industry. Membership in these groups is not mutually exclusive; it is common for members to identify with more than one social group at a time (USFS, 1995).

TABLE 3.12-1
Del Norte and Humboldt Counties Population, January 1991 to 2001

Year	Del Norte	Humboldt
1991	25,200	120,500
1992	26,500	121,900

TABLE 3.12-1
Del Norte and Humboldt Counties Population, January 1991 to 2001

Year	Del Norte	Humboldt
1993	27,000	123,300
1994	27,450	124,100
1995	27,600	124,200
1996	27,550	124,800
1997	27,950	125,600
1998	28,100	126,000
1999	27,600	125,900
2000	28,000	127,600
2001	28,100	127,800

Source: California Department of Finance, Demographic Research Unit.

3.12.2 Economic Factors

Historically lumber and wood products manufacturing have been important industries in Del Norte and Humboldt counties. The forest products industry reached a highpoint in the North Coast Region during the post-World War II housing boom in the 1950s. The industry has seen a significant decrease in employment since that time when it dominated the region's economy (USFS, 1995).

Table 3.12-2 shows the employment data for Del Norte and Humboldt counties by industry sectors. The employment distribution is similar for both counties with retail trade and services having the greatest percentage of employment. Del Norte County has a significantly higher percentage of employment in state government at 20 percent compared to 6 percent for Humboldt County. The relatively large percentage of state employees in Del Norte County is attributable to the Pelican Bay State Prison.

TABLE 3.12-2
Del Norte and Humboldt Counties Employment by Industry, 2000

	Del Norte County		Humboldt County	
Industry	Jobs	%	Jobs	%
Agriculture, Forestry, and Fishing	450	6	1,100	2
Construction and Mining	200	3	1,800	4
Lumber and Wood Products	170	2	3,700	7
Other Manufacturing	300	4	2,300	5
Transportation, Communications, and Utilities	240	3	1,900	4
Wholesale Trade	120	2	1,400	3
Retail Trade	1,410	18	10,500	21
Finance, Insurance, and Real Estate	130	2	2,200	4
Services	1,530	19	12,900	25

TABLE 3.12-2
Del Norte and Humboldt Counties Employment by Industry, 2000

	Del Norte County		Humboldt County	
Federal Government	140	2	1,000	2
State Government	1,590	20	3,200	6
Local Government	1,570	20	8,700	17
Total Employment	**7,850**		**50,700**	

Source: California Economic Development Department, California Labor Market Information Service.

As illustrated in Table 3.12-2, lumber and wood products manufacturing and forestry play a relatively small role in each county's economy in terms of employment. This is down from the industry peak during the 1950s when forest products accounted for approximately 34 percent of the North Coast region's employment (USFS, 1995). The California Employment Development Department projects little change in employment in the lumber and wood products sector in the two counties for the immediate future, with Del Norte showing no change from 1997 to 2004 and Humboldt showing a projected 14.8 percent decrease in lumber and wood production employment from 1997 to 2004.

Average annual unemployment in the two counties, as well as the State of California, is shown in Table 3.12-3. Both counties typically experience higher unemployment rates than the state as a whole. Del Norte County spent most of the 1990s in double-digit unemployment, ranging from 3 to 5 percentage points higher than the state average. Humboldt County's unemployment was only slightly over the state average for the past decade.

Simpson Timber Company, an affiliate of Simpson Resource Company, formerly employed 675 people in timberlands, milling, and administrative operations. In late 2001, Simpson Timber Company went through a restructuring in which a new company, Simpson Resource Company, was created to own and operate the timberlands. Simpson Resource Company is the permit applicant. Simpson Resource Company is currently hiring employees from Simpson Timber Company to staff the timberlands operations by mid-2002. The number of employees at Simpson Resource Company is expected to be 265, whose functions include: secretarial, bookkeeping and accounting; planning and logistics associated with resource management operations, including road construction and maintenance, site preparation, planting, vegetation control, pruning, pre-commercial thinning, commercial timber harvesting, and cone collection; and mechanical and repair activities. All these activities are conducted over the entire year; consequently, the 265 jobs are year-round jobs.

TABLE 3.12-3
County and State Unemployment, 1990 to 2000

Year	Del Norte (%)	Humboldt (%)	California (%)
1990	11.1	7.7	5.8
1991	11.1	8.5	7.7
1992	14.2	9.8	9.1
1993	13.6	9.8	9.4

TABLE 3.12-3
County and State Unemployment, 1990 to 2000

Year	Del Norte (%)	Humboldt (%)	California (%)
1994	11.9	8.6	8.6
1995	12.4	8.4	7.8
1996	10.2	7.5	7.2
1997	10.1	7.3	6.3
1998	10.3	7.2	5.9
1999	8.0	6.4	5.2
2000	8.7	6.3	4.9

Source: California Economic Development Department, California Labor Force Data.

In addition to work conducted by Simpson employees themselves, many of the forest management activities (e.g., tree planting, pre-commercial thinning, logging, fertilizer application) are contracted directly to other firms. Also, the mills dependent on Simpson Resource Company timber in the region employ approximately 410 people.

Additional contributions of the Simpson lands to local economic conditions include the indirect effect of employee wages on the purchase of goods and services from local businesses, and the contribution of yield taxes on timber purchases, which are distributed to Del Norte and Humboldt counties.